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Railway Mechanical Engineer

August 1944

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CAST STEEL HOPPER FRAMES

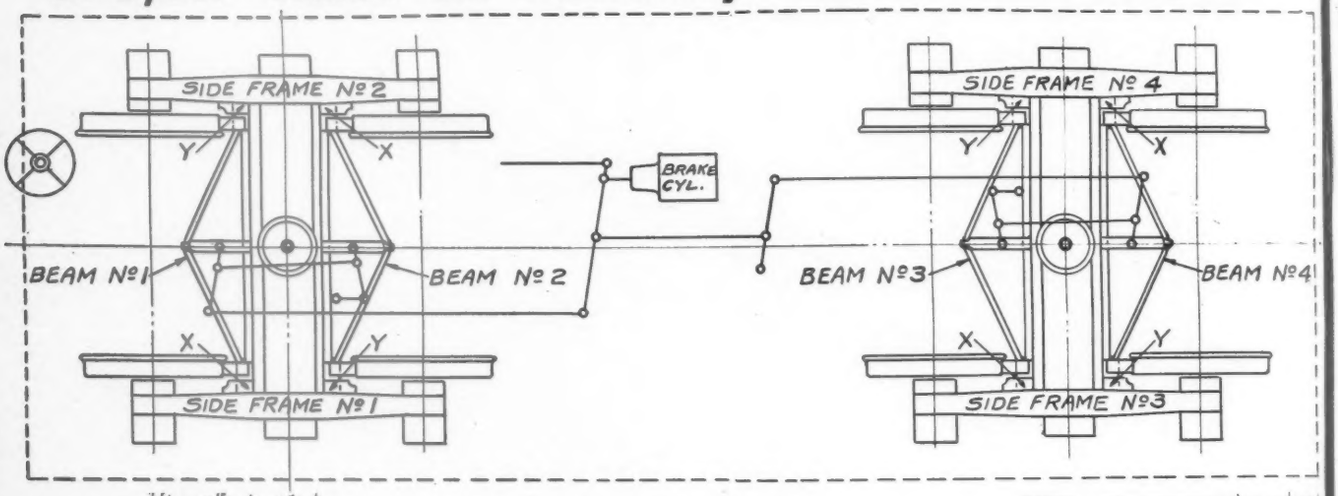
WINE

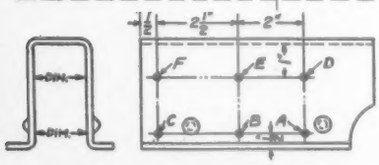
THE WINE RAILWAY APPLIANCE CO.
TOLEDO, OHIO

CERTAIN TO REACH THEIR DESTINATION
WITHOUT LOSS OF LADING

UNIT TRUCK

Report of Accumulated Wear of UNIT PARTS after 573,317 Miles on Auxiliary Water Car 600,120.

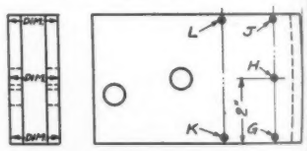




SIDE FRAME WEAR PLATE

Photographs of Parts
Will Follow In
Subsequent Issues.

Detailed Report
Sent upon Request



BRAKE BEAM WEAR PLATE

SIDE FRAME WEAR PLATES — INSIDE DIMENSIONS IN INCHES

SIDE FRAME Nº	LOCATION OF PLATE	AS APPLIED - JULY 8, 1938						INSPECTION - NOV. 1, 1938 MILEAGE 30,750						INSPECTION - NOV. 13, 1939 MILEAGE 97,280						INSPECTION - APR. 25, 1944 MILEAGE 573,317					
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	X	1.66	1.67	1.66	1.61	1.62	1.61	1.67	1.69	1.68	1.62	1.64	1.62	1.67	1.69	1.68	1.63	1.64	1.62	1.64	1.69	1.71	1.67	1.67	1.67
	Y	1.68	1.68	1.71	1.61	1.61	1.62	1.67	1.69	1.71	1.61	1.60	1.63	1.67	1.70	1.71	1.61	1.60	1.63	1.47	1.70	1.67	1.53	1.64	1.60
2	X	1.66	1.66	1.68	1.60	1.59	1.61	1.66	1.67	1.67	1.61	1.60	1.62	1.66	1.68	1.67	1.61	1.60	1.62	1.50	1.65	1.63	1.53	1.64	1.63
	Y	1.69	1.69	1.69	1.68	1.63	1.63	1.68	1.68	1.67	1.63	1.63	1.63	1.68	1.68	1.67	1.64	1.63	1.63	1.71	1.73	1.74	1.61	1.63	1.69
3	X	1.65	1.67	1.66	1.60	1.61	1.61	1.68	1.70	1.70	1.61	1.63	1.62	1.68	1.70	1.70	1.61	1.63	1.62	1.79	1.74	1.74	1.73	1.66	1.66
	Y	1.63	1.63	1.63	1.60	1.60	1.58	1.63	1.64	1.63	1.60	1.59	1.58	1.63	1.64	1.64	1.60	1.59	1.59	1.76	1.69	1.68	1.64	1.61	1.60
4	X	1.62	1.63	1.66	1.60	1.60	1.61	1.62	1.64	1.67	1.61	1.61	1.62	1.62	1.64	1.67	1.61	1.61	1.62	1.81	1.75	1.75	1.70	1.66	1.65
	Y	1.66	1.67	1.67	1.61	1.61	1.61	1.67	1.69	1.68	1.61	1.61	1.65	1.67	1.69	1.68	1.61	1.61	1.65	1.79	1.73	1.71	1.66	1.63	1.62

BRAKE BEAM WEAR PLATES — OUTSIDE DIMENSIONS IN INCHES

BRAKE BEAM Nº	LOCATION OF PLATE	AS APPLIED - JULY 8, 1938					INSPECTION - NOV. 1, 1938 MILEAGE 30,750					INSPECTION - NOV. 13, 1939 MILEAGE 97,280					INSPECTION - APR. 25, 1944 MILEAGE 573,317				
		G	H	J	K	L	G	H	J	K	L	G	H	J	K	L	G	H	J	K	L
1	X	1.52	1.52	1.53	1.53	1.53	1.46	1.51	1.49	1.53	1.51	1.46	1.50	1.49	1.51	1.49	1.31	1.50	1.48	1.44	1.49
	Y	1.52	1.51	1.51	1.52	1.51	1.47	1.51	1.49	1.52	1.51	1.47	1.51	1.49	1.50	1.51	1.29	1.48	1.46	1.50	1.50
2	X	1.52	1.51	1.51	1.51	1.51	1.46	1.50	1.48	1.51	1.51	1.46	1.49	1.46	1.49	1.50	1.20	1.50	1.38	1.24	1.47
	Y	1.52	1.51	1.52	1.53	1.53	1.46	1.51	1.52	1.53	1.53	1.43	1.50	1.50	1.53	1.53	1.17	1.50	1.39	1.53	1.56
3	X	1.52	1.52	1.52	1.54	1.54	1.45	1.50	1.50	1.49	1.53	1.43	1.50	1.47	1.47	1.53	1.33	1.48	1.42	1.44	1.50
	Y	1.53	1.52	1.52	1.53	1.53	1.48	1.51	1.51	1.53	1.53	1.45	1.51	1.48	1.53	1.53	1.28	1.49	1.44	1.50	1.53
4	X	1.52	1.51	1.52	1.52	1.52	1.51	1.51	1.50	1.52	1.52	1.44	1.51	1.47	1.49	1.52	1.32	1.50	1.43	1.43	1.50
	Y	1.52	1.52	1.52	1.53	1.53	1.46	1.50	1.47	1.49	1.50	1.42	1.50	1.47	1.49	1.50	1.36	1.47	1.47	1.52	1.54

UNIT TRUCK CORPORATION

140 CEDAR STREET — NEW YORK 6, N. Y.

Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble St reet, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies, 35 cents. Vol. 118, No. 8.

RAILWAY MECHANICAL ENGINEER

(Name Registered, U. S. Patent Office)
With which is incorporated the RAILWAY ELECTRICAL ENGINEER.

Founded in 1832 as the American Rail-Road Journal

AUGUST, 1944

Volume 118 — *No. 8*

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Published on the second day of each month by
Simmons-Boardman Publishing Corporation

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The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.), and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 560 W. Sixth street, Los Angeles 14, Calif.

Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada; 1 year, $3; 2 years, $5. Foreign countries: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

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reat Northern 50-ton, 40-ft. 6-in. plywood box car

reat Northern Builds 1,000

ifty-Ton Plywood Box Cars

Cars have welded steel frames, corrugated steel ends and steel roofs — Details of application of the plywood sheathing and lining carefully developed—Designed for high-class commodities, all interior surfaces, including floors, are treated with waterproof sealer and varnished

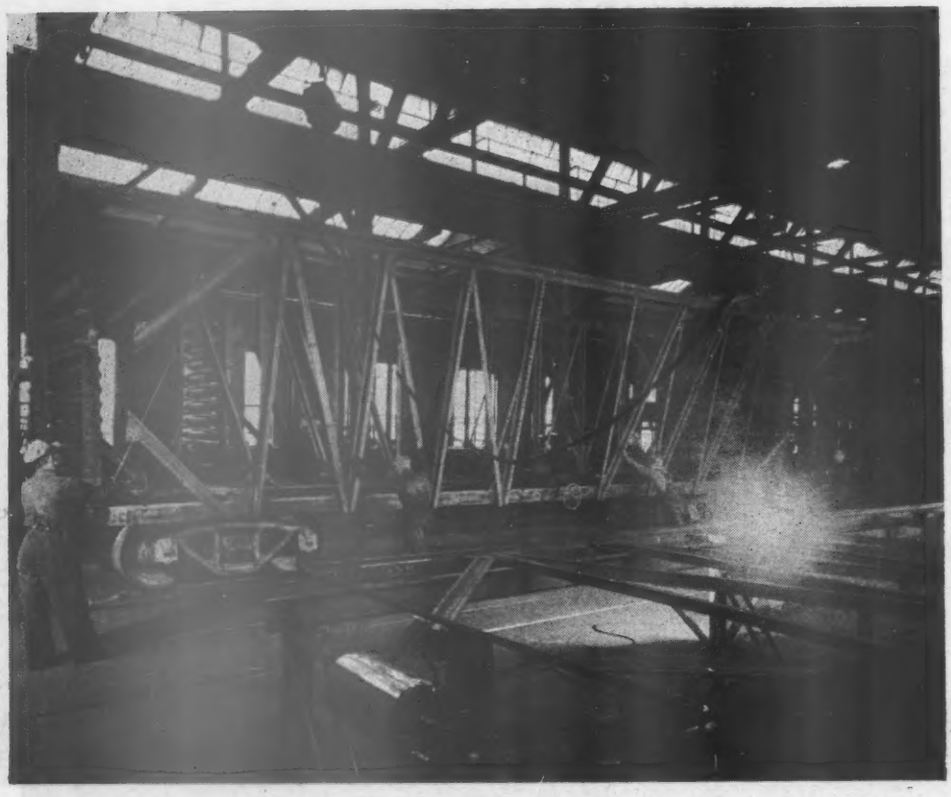
HE Great Northern is building in its own shops one ousand 50-ton, 40-ft. 6-in. high-commodity box cars, ing plywood for outside sheathing, side and end lining, d ceiling insulation. Plywood is also used in com- site doors on 600 cars. The general car dimensions d weights are given in the table, and it will be noted at, since these cars are intended to be used extensively r shipping lumber, newsprint and other high-class avy commodities, strength and ruggedness in construc- n have been secured even at some sacrifice in potential eight saving.

With certain exceptions, the underframe is constructed ng the same general lines as with riveted carbon-steel nstruction. The principal deviations are as follows: e of 7-in., 18.8-lb. special channels for side sills, this tion being more satisfactory for a composite body than e conventional type; Z-bar sills joined by a continuous nion Melt weld; body frame differing from A. A. R. ights, etc., of Z-bar side framing and other parts, the sign being based on wide past experience in the con- uction of composite box cars.

Posts and braces are welded to the side sill to the top te, being reinforced by gussets, also welded. Corner sts are a special W-section welded to the Dreadnaught el end. The steel end sections are welded together. e roof is of the Murphy all-steel riveted-assembly type.

The trucks are high-speed freight types, the majority being American Steel Foundry Ride Control and the others National B-1 and Barber Stabilized.

The cars are equipped with 5½-in. by 10-in. plain journals, one-wear wrought-steel wheels, Greco four-point brake-beam safety supports, and Universal brake slack adjusters. The composite doors on 600 cars are Camel and Superior, the former type, in an all-steel design with roller-lift door fixtures, being included on the

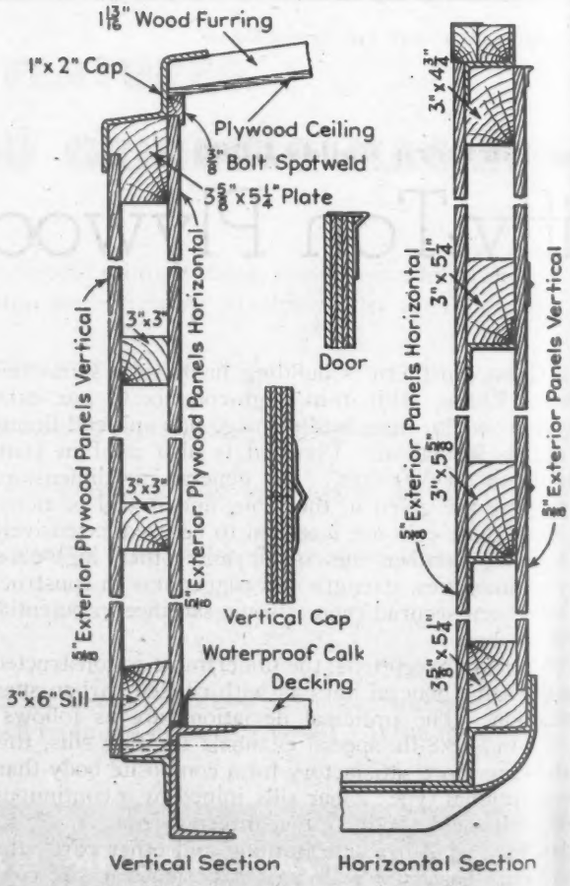


Left: Steel side frames are welded and hoisted into position for riveting and bolting to the steel under frames and ends

Below: Cross-section of box car showing particularly the use of plywood for inside lining, outside sheathing, doors and ceiling

General Dimensions and Weight of Great Northern Plywood Box Car

Capacity (nominal), lb.	100,000
Load limit, lb.	123,300
Light weight, lb.	45,700
Dimensions, ft.-in.:	
Length, inside	40-6
Width, inside	9-2
Height, inside	10-0
Side door width	6-0
Side door height	9-6 9/16
Length over end sills	40-8½
Distance between truck centers	30-8½
Journal size, in.	5½ by 10



balance of the equipment, or 400 cars. Miner and Cardwell-Westinghouse draft gears are installed; also Type AB air brakes furnished by the New York Air Brake Company; and hand brakes of the Ajax, Miner and Universal types. Side bearings are of the Barber top-hung type; brake steps, either Apex or Gypsum; and defect card holders, Apex.

Plywood Application Designed for Long Life

The use of plywood for sheathing and lining is a departure from conventional design, and since this material represents a permanent construction, expected with ordinary maintenance attention to last the service life of the car, a careful study was made of all physical properties of plywood together with positive securement methods. As a result of this study a number of features deserving detailed description were developed.

The use of plywood in freight-car construction is not new, but this is the most complete and extensive use so far made on box cars as a permanent material. The most important problems presented were protection against slow decay which may take place at vulnerable points in long-life wood construction, prevention of surface wood grain separation, and the development of positive and permanent securement of the plywood panels.

The plywood used for sheathing, side and end lining, and doors is 5/8-in. five-ply exterior grade (waterproof) sound on one side, Douglas fir. The ceiling insulation ¼-in. three-ply. All panels are furnished cut to exa size.

The panels, except ceiling, are first dipped in a speci clear sealer and surface hardener. This material is ma

up of penetrating oil containing suitable gums, and its effect is to protect the back surfaces against decay and to form a binder for the wood grain on exposed surfaces; this also serves as an excellent foundation for subsequent paint coatings. There is also good edge penetration. The bottom edges of sheathing are further waterproofed by the application of heavy coating of car cement. After application of panels to the car, the exterior is given a coat of iron-oxide primer followed by two coats of orange enamel, Great Northern shade. Side trim and stenciling are Pullman green.

The waterproof sealer on the lining protects the back face from decay and gives a tough base for the varnish, these cars having the entire interior, including the floors, varnished. Incidentally, the floor, after being sanded to a smooth surface, is also given the sealer and hardener treatment, sprayed prior to varnishing.

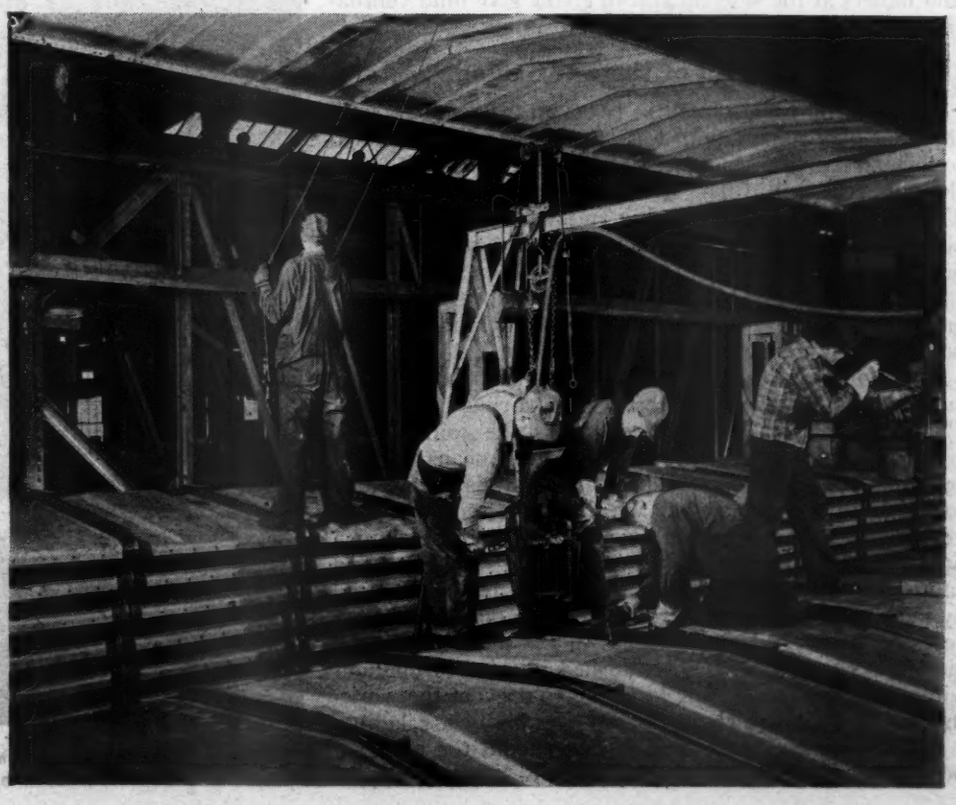
Method of Securing the Plywood Panels

Different methods of securing plywood panels to the framing were studied. A general nailing plan was developed with cup-washered bolts through siding at the side sill. The siding panels are butt jointed on the side-post nailers. The nailed butt joint permits a slight movement between adjacent panels sufficient to prevent breakage of nails or tearing of the plywood at the edges. Ply panels are exceptionally rigid and weaving stresses are not relieved by body "drumming" of panels as occurs with steel sheathing, so that if too rigidly secured weave breakage of fastening is invited. In order to make a finished job at these butt joints, a metal nailing strip punched for nailing with a V-shape raised ridge down the center is used. The V-grooves are filled with car cement as applied, which serves as a further waterproof sealer over the butt joints.

A special heavily galvanized oval-headed nail was designed for all exterior plywood nailing. The nail heads are not driven into the wood. The lining panels are laid horizontally to give maximum resistance against lading abrasion, which is mostly in the horizontal plane. The lining is face nailed with finishing nails.

Two side girths are used, more to accommodate panel widths than for nailing strength. With present plywood panel width and length restrictions removed, plywood modified to suit one girth would be practicable and would no doubt suffice. Because of plywood width restrictions.

Above right: Applying the large 5/8-in. Douglas fir plywood side panels to the car frame



Right: Sections of steel roof are riveted together and the complete roof applied to the car as a unit

The inside lining is applied in longitudinal panels

it was also necessary to use wider side post nailers than would otherwise be needed.

The lining sheets have their bottom edges embedded in car cement and rest on the top face of the top flange of the side sill. No grain trenches are used, as with plywood there is little likelihood of foreign matter getting behind the lining. Breather gains between the siding and nailers at the side sill and in girths give mild ventilation to the space between siding and lining.

Application of the End Lining

The end lining is placed in two vertical sections, with the joint glue-splined with waterproof glue. This is nailed to the end nailers. Also twelve of the end filler bolts have the nuts recessed in flanged cup washers in the plywood. This is to give a firm fastening and prevent "drumming" action against the end by lading, causing nails to work out or tear through.

The flooring is 1¾-in. tongue-and-groove and board ends butt against the inside face of the lining so that boards can be renewed without disturbing the lining.

The ceiling is ¼-in. plywood, the panels running from side plate to center and secured to carline nailers by Phillips screws. A moulding covers the joint at the ridge and is secured to ⅜-in. studs by means of nuts recessed in flanged cup washers. The studs are welded to 1¼-in by ⅛-in. plates by which each is secured to the vertical face of a carline nailing strip. At the side plate, a lip moulding covering the top edge of the side lining and supporting the outer ends of the ceiling is also secured by means of studs welded to the steel top plate, with nuts recessed in flanged cup washers in the moulding. The aim is to construct a highly-finished interior throughout without protrusions of any kind and to prevent the working out of nails which might damage high-class lading.

One advantage considered is that should the plywood be service-damaged, since it punctures without appreciable splitting or shattering, ordinary damage can be easily corrected by the use of a small inserted patch, or for smaller holes by application of a suitable filler and sealer. Another advantage of plywood, as compared to matched lumber, is its great strength and resistance to damage.

Cars Built at Superior and St. Cloud Shops

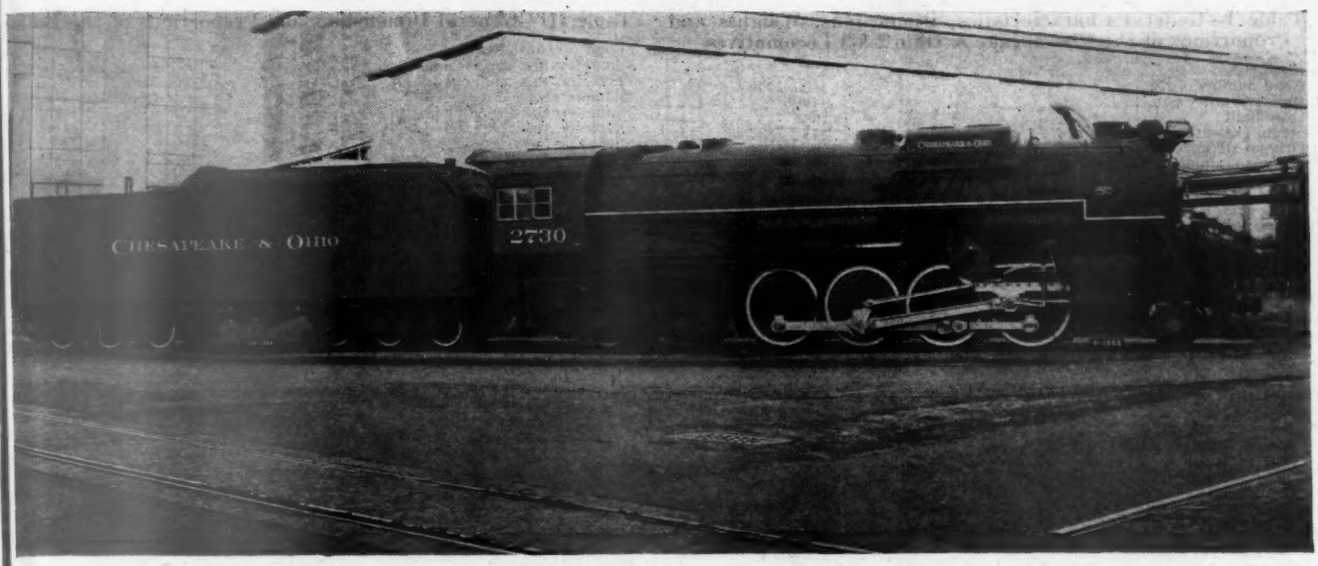
For the purpose of spreading the work of building these cars as well as to make most advantageous use of available facilities, the job is divided between the Superior, Wis., and the St. Cloud, Minn., shops of the Great Northern.

At Superior, the underframe material is fabricated and assembled, including draft gears and couplers but without the side sills. That shop is equipped with a complement of heavy machinery, special jigs, hoists, cranes, etc., including a recently installed heavy-duty Union Melt welding machine, making that plant especially adaptable for heavy steel work. The work is handled on the progressive plan, 17 car frames being turned out daily. The underframes and fabricated side sills are shipped to St. Cloud where the cars are completed.

St. Cloud is a large plant, well-equipped for general car repairing and building except heavy steel work, including appliances and special devices for efficiently handling the general assembly and finishing work. At St. Cloud, the trucks are assembled and as the underframes are received they are placed on the trucks and put in line on the assembly track. The side posts and braces are welded to the side sill at the bottom and the Yoder plate at the top, the welding assembly of the sides being made on especially arranged racks and hoists so that all welding is down-hand. The complete side frame

(*Continued on page 361*)

Steel bolts and nails are used to hold the Douglas fir plywood sheathing in place



C. & O. 2-8-4 Locomotives

Forty freight units built by Alco have 69,350 tractive lb. force and weigh 460,000 lb. Engine axles equipped with roller bearings -- Tenders have 22,000 gal. water tanks

WITHIN the past few months the Chesapeake & Ohio has taken delivery of a total of 40 freight locomotives of the 2-8-4 type from the Schenectady, N. Y., plant of the American Locomotive Company. These locomotives have as their predecessors in design a total of 94 units built both by Alco and the Lima Locomotive Works for the New York, Chicago & St. Louis and the Pere Marquette. The first of this type on these roads were a group of 15 built by Alco for the Nickel Plate in 1934.[1] All of the locomotives are of the same basic design and are an evolution in design of the Chesapeake & Ohio 2-10-4 Class T-1[2] locomotives built in 1930 by Lima. Many of the parts of the 2-8-4 type locomotives are interchangeable with the T-1's. The Nickel Plate locomotives, of which a total of 55 are in service, all have 64,100 lb. tractive force, practically identical boilers, carbon-steel rail type frames and plain bearings. The cylinders are 25 in. bore by 34 in. stroke. The Pere Marquette locomotives, of which there are 39 in service, have 26-in. by 34-in. cylinders, 69,350 lb. tractive force, and 245 lb. boiler pressure. The first 27 Pere Marquette units had rail type frames, while the last 12 had cast-steel beds. All 39 units have plain bearings. There were 10 of the Pere Marquette units equipped with trailer boosters. All 94 of the previously built locomotives had 22,000-gal. tender tanks with a fuel capacity of 22 tons. Forty of the Nickel Plate units and all of the Pere Marquette units were built by Lima.

The present Chesapeake & Ohio locomotives described in this article represent another step in the refinement of design and the application of modern specialties. These 40 locomotives have cast beds and roller bearings; 83,750 lb. tractive force, including the booster; 26-in. by 34-in. cylinders, and a total engine weight of 460,000 lb.

Boiler Design and Construction

The boiler is the conical type consisting of three courses, the second course being tapered. The inside diameter of the first course is 86 in. and the outside diameter of the largest course is 98 in. The barrel and firebox plates are carbon steel. The boiler is designed for a working pressure of 245 lb. The total calculated evaporation is 66,260 lb. per hour, equivalent to a boiler horsepower of 3,186. The dimensions and characteristics of the boiler are shown in one of the tables.

The fireboxes are 135 1/16 in. long by 96 1/4 in. wide, and the grate area is 90.3 sq. ft. The combustion chamber is 42 in. long. The firebox and combustion chamber are of welded construction, except for the back flue sheet and furnace door-sheet connections. The latter are seal welded. The fireboxes have Firebar grates and fuel is fed to the grates by a Standard Type MB stoker. Flannery flexible staybolts are used in the back head, the breaking zones of the firebox, in the combustion chamber, and in the throat sheet.

The firedoor is the Franklin No. 8. Two Nicholson Thermic syphons located in the firebox, together with two 3 1/2-in. arch tubes, support the Security brick arch.

There are 73 fire tubes, 2 1/4 in. diameter, and 202 superheater flues, 3 1/2 in. diameter, in which is applied the Elesco Type E 103-unit superheater. An American multiple throttle is located in the superheater header.

The water is fed to the boiler by a Nathan type NL-4000 9,000-gal. capacity injector located on the right side of the boiler and a Worthington 5 1/2-SSA type feedwater heater having a nominal capacity of 10,000

[1] See Railway Mechanical Engineer, November, 1934, page 387.
[2] See Railway Mechanical Engineer, November, 1930, page 614.

Table I—General Characteristics, Dimensions, Weights and Proportions of the Chesapeake & Ohio 2-8-4 Locomotives

Road class	K4
Road number	2700–2739
Builder's order number	S1905
Date built	1944
Steam pressure, lb. per sq. in.	245
Drivers, diameter, in.	69
Cylinders, number, diameter and stroke, in.	2—26 x 34
Rated tractive force, engine, lb.	69,350
Rated tractive force, booster, lb.	14,400
Valve gear, type	Baker
Valves, piston, diameter, in.	14
Maximum travel, in.	8
Steam lap, in.	1¾
Exhaust clearance, in.	1/8
Lead, in.	3/32
Cut-off in full gear, per cent	78.6
Dimensions:	
Height, rail to top of stack, ft.-in.	15–7
Height, rail to center of boiler, ft.-in.	12–6½
Width overall, ft.-in.	10–9
Length over engine and tender, ft.-in.	105—7⅞
Cylinder centers, in.	91½
Wheel bases, ft.-in.:	
Driving	18–3
Engine, total	42–0
Engine and tender, total	93–2
Weights, lb.:	
Front truck	44,500
Drivers	292,000
Trailer truck	123,500
Engine, total	460,000
Tender (2/3 loaded)	312,800
Weight on drivers, per cent weight of engine	63.4
Weight on drivers ÷tractive force	4.21
Tender:	
Style or type	Rectangular
Water capacity	21,000
Fuel capacity, tons	30
Trucks	Six-wheel

Table III—General Dimensions and Proportions of the Boiler

Steam pressure, lb.	245
Diameter, first ring, inside, in.	86
Diameter, first ring, outside, in.	87⅝
Diameter, second ring	Conical
Diameter, third ring, inside, in.	95⅞
Diameter, third ring, outside, in.	98
Sheet thickness, In.:	
Smokebox	9/16
First ring	11/16
Second ring	1 1/16
Third ring	1 1/16
Back head	9/16
Side sheets	5/8
Roof sheet	1
Furnace door sheet	3/8
Furnace side sheets	3/8
Furnace crown sheet	3/8
Combustion chamber	3/8
Front tube sheet	3/4
Back tube sheet	9/16
Throat sheet, outside	1
Throat sheet, furnace	9/16
Flexible staybolts, number and location:	
Throat sheet	146
Back head	81
Side sheets	394
Combustion chamber	358
Firebox length, in.	135 1/16
Firebox width, in.	96¼
Distance center line of boiler to crown sheet, front	20⅝
Distance center lines of boiler to crown sheet, back	14
Water space, front, in.	6½
Water space, back, in.	6
Water space, sides, in.	7
Combustion chamber length, in.	42
Arch tubes, number and diameter	2—3½
Syphons, number and location	2—firebox
Tubes, number and diameter	73—2¼
Tubes, thickness (B.W.G.)	No. 12
Flues, number and diameter	202—3½
Flues, thickness (B.W.G.)	No. 11
Length over tube sheets, ft.-in.	19
Net gas area through tubes and flues, sq. ft.	10.0
Superheater, type	E
Fuel	Bit. coal
Grates, type	Firebar
Grate area, sq. ft.	90.3
Stoker, type	Standard MB
Feedwater heater, type	Worthington 5½ SSA
Heating surfaces, sq. ft.:	
Firebox and combustion chamber	340
Arch tubes	19
Syphons	103
Firebox, total	462
Tubes	812
Flues	3,496
Evaporative, total	4,770
Superheater	1,949
Combined evap. and superheat	6,719
Boiler proportions:	
Firebox heat. surf., per cent comb. heat. surf.	6.9
Tube-flue heat. surf., per cent comb. heat. surf.	64.1
Superheat. surf., per cent comb. heat. surf.	29.0
Firebox heat. surf. ÷grate area	5.12
Tube-flue heat. surf. ÷grate area	47.7
Evap. heat. surf. ÷grate area	52.8
Superheat. surf. ÷grate area	21.5
Comb. heat. surf. ÷grate area	74.4
Gas area ÷grate area	0.11
Tractive force ÷grate area	768.0
Weight of engine ÷evap. heat. surf.	96.4
Weight of engine ÷comb. heat. surf.	68.4
Tractive force ÷evap. heat. surf.	14.5
Tractive force ÷comb. heat. surf.	10.3
Tractive force x diameter drivers ÷comb. heat. surf.	712.1

gals. per hour. The boiler is equipped with three 3½-in. safety valves.

Foundation and Running Gear

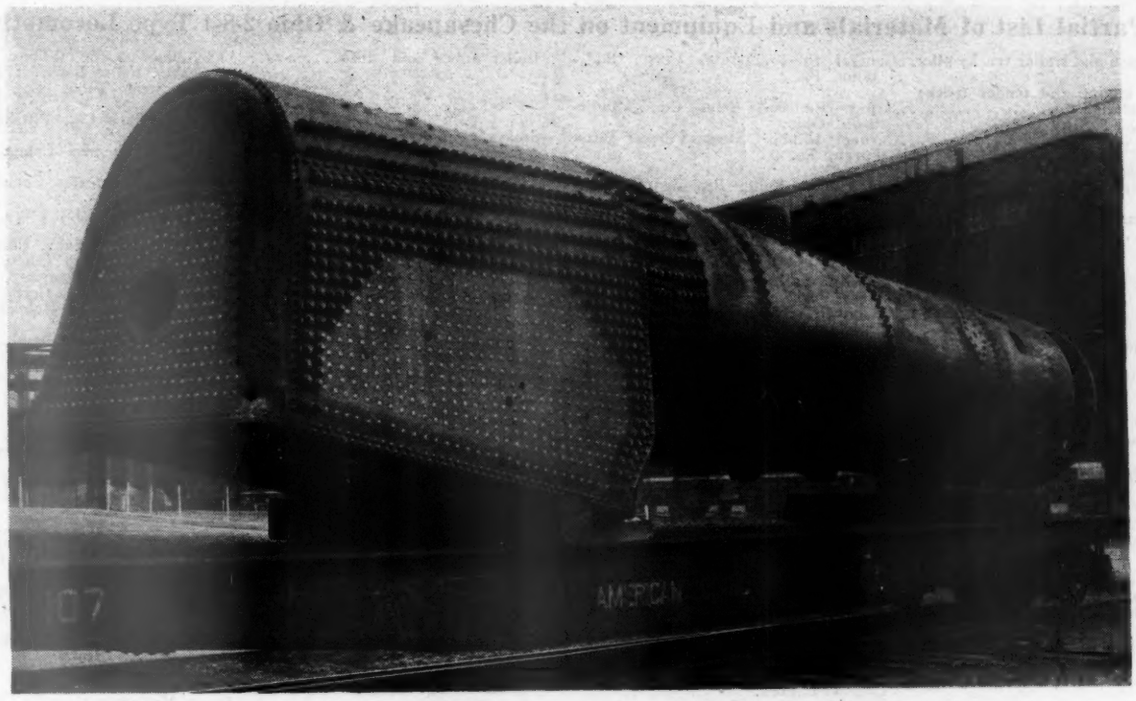
The foundation of these locomotives consists of a General Steel Castings Corporation cast-steel bed, of which the back cylinder heads, air-pump brackets, injector brackets, front deck, cradle, guide and reverse-shaft support, cold-water pump support, and furnace bearers are an integral part. Ex-Cell-O bushings are applied in the bed for all spring- and brake-rigging pins. The engine truck is the General Steel Castings Corporation two-wheel outside bearing type having a cast-steel frame interchangeable with the C. & O. 2-10-4 Class K-1 locomotives. These trucks are designed for an initial resistance of 30 per cent and a constant resistance of 25 per cent with ⅛-in. lateral on each side. The swing of the front truck is 7 in. on a 20-deg. curve. The trucks have medium-carbon axles mounted in Timken roller bearings and multiple wear rolled-steel wheels.

The trailing trucks are the General Steel Castings Corporation four-wheel Delta type similar to those supplied for the C. & O. Class L-2 locomotives. These trucks are designed with 1-in. lateral at the front and 3/16-in. on each side at the rear wheels. Both initial and constant resistance are 15 per cent. The Timken lateral-motion control device is applied to the front trailer-truck boxes and the Franklin C2S booster drives on the rear trailer-truck wheels. Both front and rear trailer-truck axles run in Timken roller bearings.

The driving-wheel centers are the spoke type, cast-steel, on which are mounted 69-in. tires. Wheel centers are

Table II—Axles, Bearings, Wheels and Tires

	Axles				Wheels or Tires			Wheel Centers		
Location	Material	Manufacturer	Bearings	Journal size, in.	Type and material	Manufacturer	Diam., in.	Type	Manufacturer	Diam., in.
Front truck	Medium carbon	Carnegie-Illinois	Timken	7½	Multiple-wear rolled steel	Armco	33	.....	....	.....
Drivers, main	Medium carbon hollow bored	Carnegie-Illinois	Timken	13	Class B	Railway Steel Spring Div. Alco	69	Cast steel	Alco	62
Drivers, other	Medium carbon hollow bored	Carnegie-Illinois	Timken	12⅜	Class B	Railway Steel Spring Div. Alco	69	Cast steel	Alco	62
Trailer, front	Medium carbon	Carnegie-Illinois	Timken	12⅜	Multiple-wear rolled steel	Armco	36	.....	....	.....
Trailer, rear	Medium carbon	Carnegie-Illinois	Timken	12⅜	Class B	Railway Steel Spring Div. Alco	43	Cast steel	....	36
Tender	Open hearth	Carnegie-Illinois	Plain	7x14	Multiple-wear rolled steel	Armco	36	.....	....	.....



mounted on medium-carbon steel hollow-bored axles operating in Timken bearings. The Alco lateral-cushioning device is used on the front drivers.

The total weight of the reciprocating parts on one side is 2,395 lb. The overbalance is distributed 210 lb. to the front and back wheels, 225 lb. to the intermediate wheel, and minus 41 lb. to the main wheel. The dynamic augment at 69 m.p.h. is 11,500 lb. front and back; 12,300 lb. at the intermediate, and minus 2,250 lb. at the main.

The cylinders are 26-in. bore by 34-in. stroke. Both cylinders and valve chambers are equipped with Hunt-Spiller gun-iron bushings as well as Hunt-Spiller valve bull rings and valve packing rings. The pistons are cast-steel centers with Hunt-Spiller bull rings and duplex packing rings. The piston rods are openhearth carbon steel, quenched and tempered, operating in King type packing.

The crossheads and guides are the multiple-bearing type with carbon-steel wrist pins and chrome-vanadium cross head keys. The crossheads are lined with Satco metal. The main and side rods are of medium carbon steel, the main rod being of I-section and the side rods of rectangular section. The rods are the tandem type. Magnus bronze bushings are applied to the side rods and, where floating bushings are used, the bronze bushings operate in Hunt-Spiller gun-iron fixed bushings. The crank pins are medium-carbon steel, normalized and tempered, having journal diameters for the side rods of 6 in. at the front, intermediate, and back pins, and 9¾ in. at the main pin. The main pins are hollow bored with 8¼-in. by 9-in. journals for the main rod.

The 14-in. piston valves are controlled by the Baker valve gear which, in turn, is actuated by a Franklin type F-2 reverse gear.

The chassis of these locomotives are equipped for complete mechanical and pressure-grease lubrication. Force-fed lubrication is supplied by a Nathan 12-feed, 36-pint lubricator located on the left side of the locomotive supplying oil to the pedestal faces, valve crosshead, engine-truck center-pin guide, radial buffer, and furnace bearers. Lubrication for steam-pipe cylinders, guide, feedwater heater, filter, and air pump is supplied by a Detroit 15-feed, 32-pint lubricator located on the right side of the locomotive. Numerous parts on the running gear are equipped with Alemite fittings for grease lubrication.

These locomotives are equipped with the Pyle-National headlight and generating equipment having a type MO-6 800-watt, 32 volt turbo generator designed for operation with 300 lb. pressure saturated steam. Ten of the locomotives are equipped with the Union Switch & Signal Company's intermediate inductive train stop designed for operation in forward direction only.

The foundation brake equipment, Schedule N-290-100, was supplied by the Westinghouse Air Brake Company and the New York Air Brake Company and is designed with a braking power equivalent to 50 per cent of the weight on drivers. The driver-brake rigging is designed for 100 lb. cylinder pressure. The operating brake equipment is No. 8ET with two 8½-in. cross-compound compressors. The locomotives are supplied with two 18½-in. by 108-in. and one 18½-in. by 72-in. main reservoirs.

The cabs are of welded-steel construction having a length over the front and back walls of 95⅛ in. and a distance of 69 in. from the back corner of the firebox to the front wall of the cab. The windows in front of the cab are the Prime clear-vision type. A single seat for the engineman is located on the right side of the cab and two seats for the fireman and the brakeman on the left side.

The Tender

The tenders are the rectangular tank type with two six-weel trucks. The tanks have a water capacity of 21,000 gals. and the coal space has a capacity for 22 tons. The tender has a wheel base of 37 ft. 1 in. with a 10-ft. wheel base for each truck. The light weight of the tender is 158,300 lb.

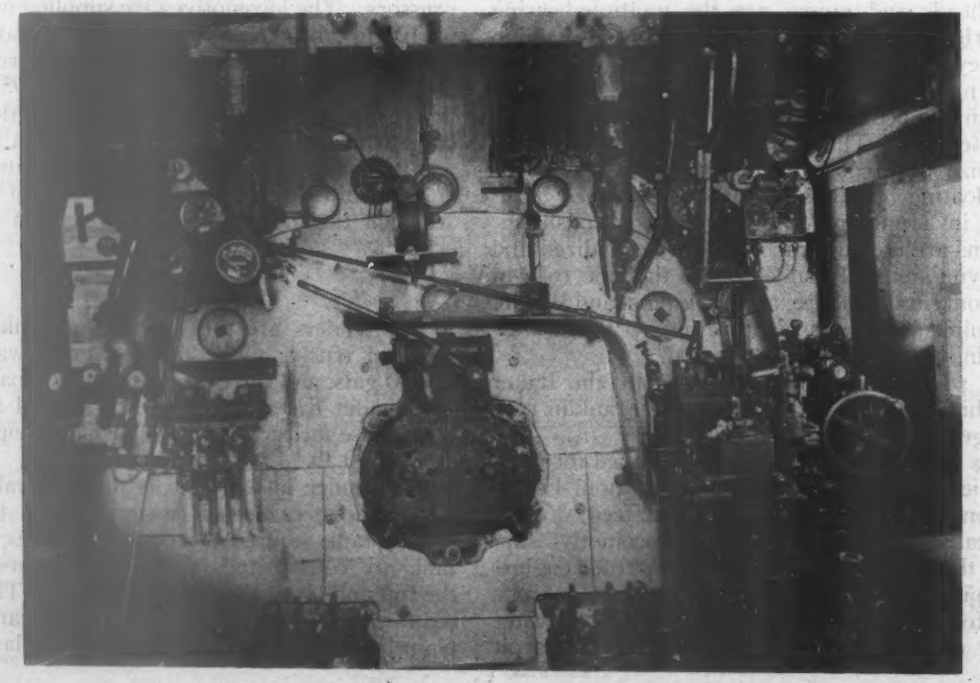
The tender underframe is the General Steel Castings Corporation cast-steel water-bottom type with the riveted tank secured thereto. The sides and ends of the tank are constructed of $\frac{5}{16}$-in. carbon-steel plates and the top and slope sheet of ½-in. steel. The tender trucks are the Buckeye six-wheel type with carbon-steel axles, plain bearings, and A. S. F. Simplex clasp brakes. The

Partial List of Materials and Equipment on the Chesapeake & Ohio 2-8-4 Type Locomotives

Bed; engine and trailer truck; pilot	General Steel Castings Corp., Eddystone, Pa.
Wheels; engine and tender truck; jacket steel	Armco Railroad Sales Co., Middletown, Ohio.
Axles	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Engine—truck, trailer truck and tender-truck roller bearings	The Timken Roller Bearing Co., Canton, Ohio.
Lateral cushioning device	American Locomotive Co., New York.
Bumper	Ohio Steel Foundry Co., Lima, Ohio.
Drawbar and safety bar; radial buffer; reverse gear; booster; firedoor	Franklin Railway Supply Co., Inc., New York.
Springs	Pittsburgh Spring and Steel Co., Pittsburgh, Pa.
Pilot coupler and pocket	National Malleable and Steel Castings Co., Cleveland, Ohio.
Brake equipment	New York Air Brake Co., Watertown, N. Y. Westinghouse Air Brake Co., Wilmerding, Pa.
Brake shoes	American Brake Shoe Company, New York.
Sanders; rod packing	U. S. Metallic Packing Co., Philadelphia, Pa.
Bushings for brake and spring hangers; bushings and pins	Ex-Cell-O Corporation, Detroit, Mich.
Valves	The Lunkenheimer Company, Cincinnati, Ohio. Ohio Injector Co., Wadsworth, Ohio.
Cylinder and valve bushings; piston bull and packing rings; valve rings; bell	Hunt-Spiller Manufacturing Corporation, Boston, Mass.
Rod bushings	Hunt-Spiller Manufacturing Corporation, Boston, Mass. Magnus Metal Div., National Lead Co., New York.
Valve gear	Pilliod Co., New York.
Washout plugs	Huron Mfg. Co., Detroit, Mich.
Lock nuts	Grip Nut Co., Chicago.
Mechanical lubricators	Detroit Lubricator Co., Detroit, Mich. Nathan Manufacturing Co., New York.
Grease fittings	The Prime Manufacturing Co., Milwaukee, Wis. Alemite Div., Stewart-Warner Corp., Chicago.
Boiler and firebox steel	Carnegie-Illinois Steel Corp., Pittsburgh, Pa. Lukens Steel Co., Coatesville, Pa. Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Boiler braces and pins	Ewald Iron Co., Louisville, Ky.
Staybolts	Ewald Iron Co., Louisville, Ky. Flannery Bolt Co., Bridgeville, Pa. Ulster Iron Works, Dover, N. J.
Arch tubes	National Tube Co., Pittsburgh, Pa.
Syphons	Locomotive Firebox Co., Chicago.
Boiler tubes and flues	The Babcock & Wilcox Tube Co., Beaver Falls, Pa. Globe Steel Tubes Co., Milwaukee, Wis. National Tube Co., Pittsburgh, Pa.
Stoker engine and feedwater pump throttle	The Lunkenheimer Company, Cincinnati, Ohio.
Arch brick	General Refractories Company, Philadelphia, Pa.
Throttle valve	American Throttle Co., Inc., New York.
Blowoff cocks	The Okadee Company, Chicago.
Blowoff muffler	Wilson Engineering Corp., Chicago.
Superheater	The Superheater Company, New York.
Lagging	Johns-Manville Sales Corp., New York.
Pipe covering	Union Asbestos & Rubber Co., Chicago.
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Injector; injector check; feedwater heater check; low-water alarm; water column; gage cocks; water gages; cab turret valves; water gage valves; whistle	Nathan Manufacturing Co., New York.
Firebar grates	Waugh Equipment Co., New York.
Stoker	Standard Stoker Co., Inc., New York.
Clear vision window	The Prime Manufacturing Co., Milwaukee, Wis.
Headlight and generator; cab lamps; classification lamp; backup lamp	The Pyle-National Company, Chicago.
Train control	Union Switch & Signal Co., Swissvale, Pa.
Piping	A. M. Byers Co., Pittsburgh, Pa.
Whistle operating valve	Viloco Railway Equipment Co., Chicago.
Bell ringer	Railway Service and Supply Corp., Indianapolis, Ind.
Flexible connections between engine and tender; automatic drain cocks	Barco Manufacturing Co., Chicago.
Tender:	
Tank steel	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Tank rivets	Champion Rivet Co., Cleveland, Ohio.
Tank valves	Wm. Powell Co., Cincinnati, Ohio.
Frame	General Steel Casting Corporation, Eddystone, Pa.
Frame plugs	Huron Mfg. Co., Detroit, Mich.
Trucks; draft gear yokes	Buckeye Steel Castings Co., Columbus, Ohio.
Spring snubbers	Cardwell Westinghouse Co., Chicago.
Coupler; journal box lids	National Malleable and Steel Castings Co., Cleveland, Ohio.
Brakes	American Steel Foundries, Chicago.
Brake shoes and keys	American Brake Shoe Company, New York
Draft gear	W. H. Miner, Inc., Chicago.
Drawbar pin	Ewald Iron Co., Louisville, Ky.
Journal bearings	Magnus Metal Div., National Lead Co., New York.

tender brake cylinders, 14-in. by 12-in., are mounted on the frame and the brake equipment is designed to apply a braking load of 70 per cent of the light weight of the tender at 50-lb. cylinder pressure.

The Franklin E2 radial buffer is used between engine and tender and Barco flexible connections are used for engine and tender steam and air lines. The tender draft gear is Miner A22XB.



Swedish Railways Install

All-Welded Tank Cars

By Albin Andersson*

A NEW type of all-welded tank car is being placed in service on the Swedish State Railways. Built by the firm of Chr. Olsson, with shops in Stockholm, these cars differ in design and construction from standard tank cars of the usual type. Many tank cars built in recent years have had welded tanks but in the Olsson cars practically the whole structure is welded. They have thus no separate underframe, in the usual sense of this term, but merely, at each end, a fixed, two-wheel frame welded to the tank, and consisting of bearing forks, buffer beam, draw box and cross members. These end parts carry the buffers, draw gear, spring suspension, and brake devices.

The tank for two-axle cars has a capacity of from 4,000 to 7,000 imp. gal., with diameters respectively of approximately 71 in. and 105 in. Plate thicknesses are about 0.32 in. in the body portion of the tank and 0.39 in. in the

(*Continued on page 361*)

* Engineering department, Swedish State Railways.

Above: Welded tank car which has been built without the use of the conventional center sill construction

Above left: The two-wheel trucks are equipped with roller bearings

Right: End cradles to support the tank and which carry all truck and draft gear attachments are welded directly to the tank

Left: Pvt. Anthony Zahar, Brooklyn, N. Y., cleans a headlight lens in an enginehouse of the Bengal & Assam

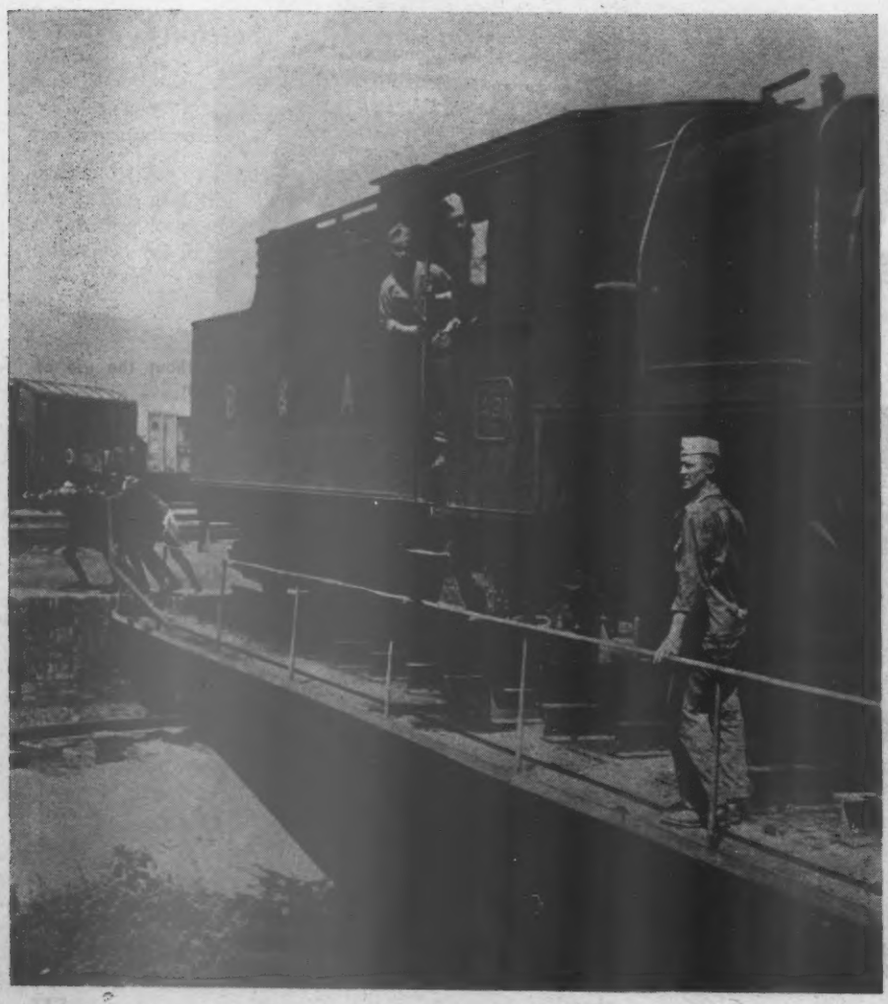
Right: Pvt. Frank Yakaites, Fond du Lac, Wis., formerly with the Soo Line, supervises an Indian who is cleaning the smoke-box of a Bengal & Assam locomotive

Below left: A Bengal & Assam meter-gauge locomotive is turned by Indian laborers—On the engine, left to right, are Pvt. Quentin Carbone, Woodhaven, N. Y., formerly with the Long Island; Pvt. Hellmuth Asmus, Staten Island, N. Y., and Pvt. Jostph Beres, Buffalo, N. Y.

Bengal & Assam Operated by

Military Railway Service

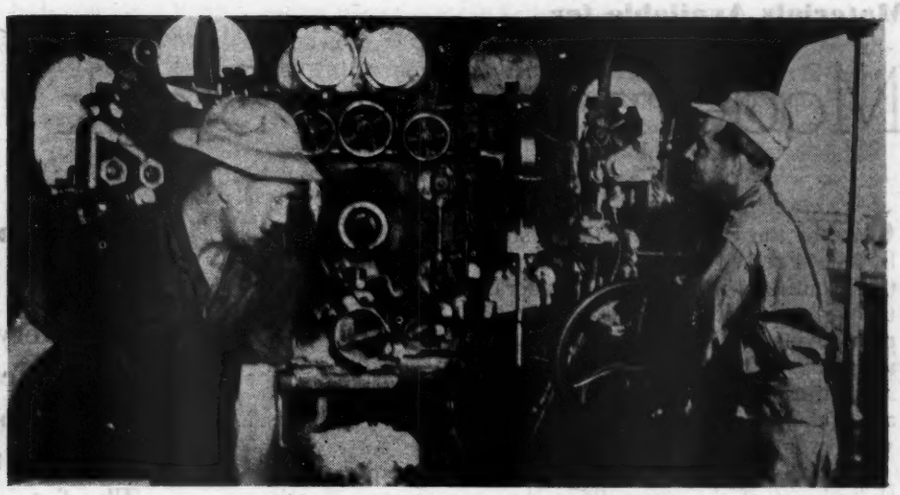
U. S. War Department Photographs



WHEN American railroad troops took over portions of the Bangal & Assam Railway virtually the only supply route for the men engaged in building the Ledo Road and for General Stillwell's troops in Northern Burma, they encountered two major stumbling blocks—the first, now nearly corrected, that of transshipping freight from broad-gauge to meter-gauge line; the second, involving ferrying of cars on small barges across the Brahmaputra River, the varying level of which from dry to monsoon season prevents bridge construction. With the advent of the Military Railway Service tempo at the ferry point and on the whole line soon picked up. Though Indians were still employed, whenever there was chance of delay American railroaders were quick to step in. In the first two months under the new operation, there was roughly a 40 per cent increase in the volume of traffic handled.

The statement that "it is no exaggeration to say that the railway was being operated by our men very close to the ...

T/4 C. E. Roth, Canandaigua, N. Y., a former N. Y. C. worker, greasing a locomotive



nes," made by one officer tells its own tory.

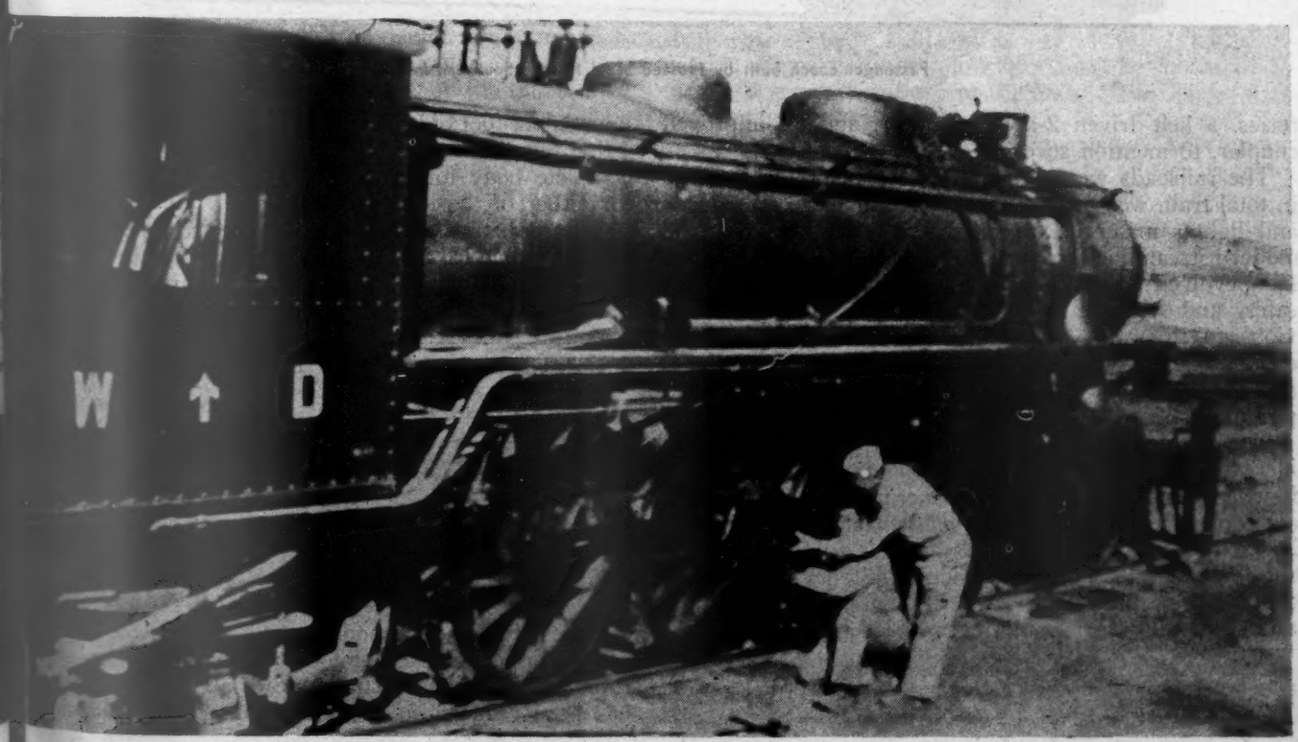
When the M. R. S. was set up in the hina-Burma-India theater of operation nder Brig. Gen. Thomas B. Wilson, his rganization included a number of ex-rail-oaders. They were: Col. John A. Apple-n (Penna.), who was there at the start; t. Col. Martin Goerl (N. Y. C.); Lt. Col. tanley H. Bray (S. P.); Lt. Cols. H. B. loyt and Karl F. Emmanuel (N. Y. C.); t. Col. George R. Branch (C. R. I. & P.); t. Col. Harvey B. Pilcher (Wabash); Lt. ol. W. P. Wilson (C. B. & Q.); Lt. Col. lva C. Ogg (T. & P.); Lt. Col. Clarence Conlisk (A. T. & S. F.) and Maj. ubert M. Phillips (Penna.). Lt. Col. larion B. Richardson, formerly a mem-r of the editorial staff of the *Railway echanical Engineer*, is Director of Sup-y for the Transportation Service.

Upper left: Corp. Joseph Bassallo, Croton-on-Hudson, N. Y., formerly with the New York Central, works on an engine on the meter-gauge Bengal & Assam

Upper right: Pvt. Nelson B. O'Brien, Croton-on-Hudson, N. Y., formerly with the New York Central, putting coal on the fire, and Pvt. Dominic J. DeJerolme, Niles, Ohio, formerly with the Erie, on the engineman's seat of a Bengal & Assam locomotive

Right: Pvt. Michael J. Masone, Queens, N. Y., coupling cars on the Bengal & Assam

Below: Corp. Joseph Bassallo and Capt. Harry E. Owens, Mattoon, Ill., both former New York Central men, check a rod on a U. S. A. meter-gauge locomotive on the Bengal & Assam



Materials Available for

Modern Rolling Stock*

By Stephen H. Badgett†

A variety of materials, made available in recent years, has made possible the development of the lightweight car. The future will offer still further weight-reducing designs

ONE of the earliest so-called "steel" coaches was built by the Pressed Steel Car Company and delivered to the Southern in 1906. Considerable wood was used throughout; both the body and trucks being of a composite construction. The coach was about 74½ ft. long, weighing 110,100 lb. and seating 73 passengers. The specialties were rather few; consisting in part of plain air brake, high-pressure steam heat, Pintsch gas lights, walk-over seats, and so on.

The all-steel coach of the late '20's, common before the advent of the streamliner, was constructed of relatively heavy mild steel sections and the general interior finish was also fabricated of steel. The clerestory type of roof was yet in vogue and the fish-belly center sill in combination with a steel platform and bolster casting was still common though being somewhat displaced.

A typical coach of this era was about 79 ft. long, weighing 130,500 lb., and seating 84 passengers. The specialties had both been improved and increased in number; now including an air brake with a universal valve, batteries, a belt-driven 2-kw. generator, and an improved coupler, to mention several.

Passenger coach built by Pressed Steel for the Southern in 1906

The railroads were becoming alarmed at the increase in total train weight with no revenue increase. Stronger and lighter materials of construction were offered, the modern streamlined coach was developed, and the A. A. R. later evolved a specification setting forth a standard for safety and strength in passenger car design. Just previous to this war, a typical deluxe streamlined coach of riveted and welded low-alloy steel construction was about 85 ft. long, weighing 121,000 lb. and seating 56 passengers.

The specialty items had been further improved and increased in number; electro-pneumatic control devices having been added to the air brake, modern lighting and air conditioning requiring larger capacity batteries and 20 kw. generators, improved seating, air-pressure water system, and others. Streamlining required a skirting and a full end closure. The brake cylinders, roller bearings, and cushioning devices had been added to the trucks.

Table I compares the steel coach weights of the three eras and further subdivides them into components in order to illustrate the individual trends.

Table II reduces the weights to the common base of pounds per foot of length. Notice in comparison to Table I that the per-foot weights of the complete car and of the complete body for the deluxe coach are both less than for either of the other two coaches.

The reduction of the weight figures to a per-passenger basis in Table III is a method of comparing the amount of service the individual passenger of the three eras received from the railroads. In order directly to compare the late twenties coach with a modern coach, the deluxe coach has been stripped of the comfortable lounge rooms, substituting small toilets in their stead, and the seat spacing has been reduced so as to accommodate 84 passengers.

Table I—General Trend in Steel Coach Weight

	1906 coach	Late twenties' coach	Modern deluxe coach
Weight of complete car, lb.	110,100	130,500	121,000
Weight of two trucks, lb.	36,500	33,680	39,000
Weight of complete body, lb.	73,600	96,900	82,000
Weight of body specialties, lb.	11,000	40,300	48,500
Weight of body without specialties, lb.	62,600	56,600	33,500
Body specialties proportion of complete body, per cent	15	42	59
Length of car, ft.	74½	79	85
Number of passengers	73	84	56

* Abstract of a paper presented at the semi-annual meeting of the American Society of Mechanical Engineers, Railroad Division, Pittsburgh, Pa., June 20, 1944.

† Mechanical engineer, Pressed Steel Car Company.

These figures are tabulated in the last column. With reference to the weight of complete car and weight of complete body, this added column emphasizes the additional comforts of the large lounge rooms and the spacious seating with a decrease in total coach revenue and an increase in the weight hauled per passenger. This may be presented as an argument for further decreasing the complete car weight in order to increase the revenue per passenger pound.

Table II—Trend in Coach Body and Specialty Weights, Per Foot of Length

	1906 coach	Late twenties' coach	Modern deluxe coach
Length over-all, ft.	74½	79	85
Weight of complete car, lb.	1,480	1,655	1,425
Weight of complete body, lb.	985	1,225	965
Weight of body specialties, lb.	145	510	570
Weight of body without specialties, lb.	840	715	395

Omitting the 56 passenger coach for the present, the weight of body specialties shows that the service per passenger in the form of comfort and safety attributable to the specialties has been considerably increased. Now considering the deluxe coach, this service is abruptly increased to almost twice that of the late twenties coach. The fewer passengers also provide less revenue out of which to amortize this increased cost. The columns containing the weight of body without specialties accentuate the body weight reduction per passenger without penalizing the strength or safety of the structure.

Tables I through III place emphasis on the remarkable service being offered by the railroads to the public through the medium of the deluxe cars. The specialties hold a field for weight reduction, dependent upon certain factors which will be discussed later.

The non-structural material of a coach holds an opportunity for the application of magnesium and the justification for its use will be its cost-weight ratio. While certain new variations in alloys will be placed on the postwar market, it is doubtful that any radically different materials or combinations suitable for railroad rolling stock structures will immediately appear. The problem facing us is rather the placing of existing materials of construction into their proper economic sphere of use.

We are all probably familiar with the use of steel in the modern streamlined car. The structure is of an alloy steel, the trucks of alloy- or common-steel castings, the equalizers and axles of steel forgings and so on.

The elastic modulus of steel is around 30,000,000 lb. per sq. in. and the low alloy steels generally have yields in the neighborhood of 50,000 lb. per sq. in. Table IV sets forth some physical data for steel and compares the basic design stresses for a low-alloy and an open hearth steel. The A. A. R. passenger car specification outlines a series of allowable stresses based on open hearth steel with a yield of 32,000 lb. per sq. in. This specification states that the allowables may be increased by the yield strength ratios; in this case 50 to 32, or a 56 per cent increase.

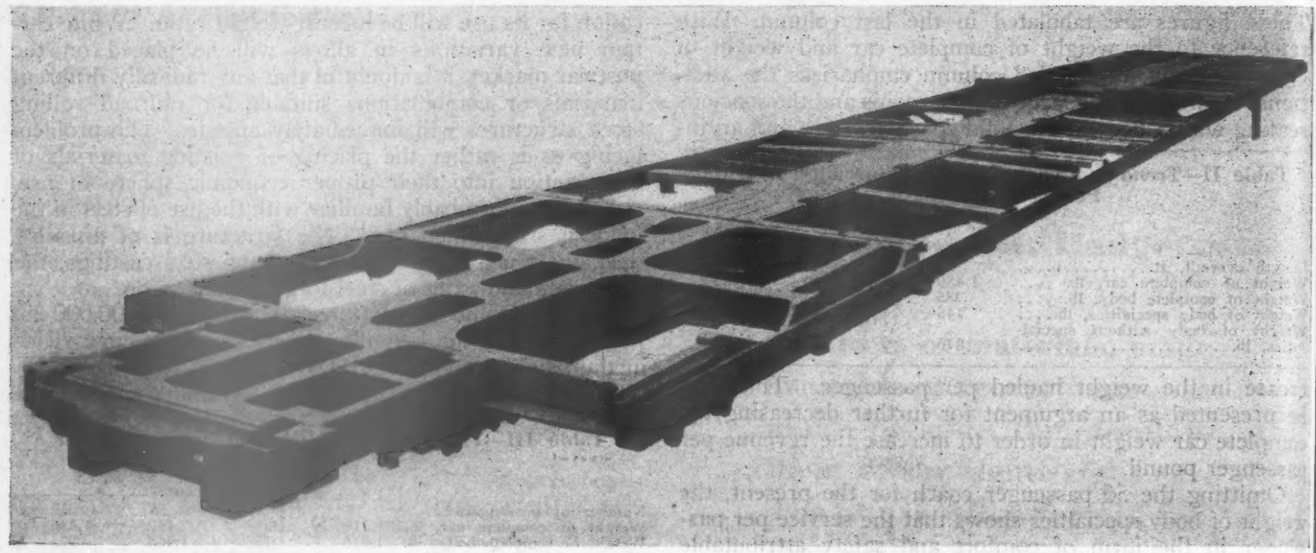
Table III—Trend in Coach Weight Per Passenger

	1906 coach	Late twenties' coach	Modern deluxe coach	
Number of passengers	73	84	56	84 (assumed)
Weight of complete car, lb.	1,510	1,555	2,160	1,440
Weight of complete body, lb.	1,010	1,155	1,465	975
Weight of body specialties, lb.	150	480	865	575
Weight of body without specialties, lb.	860	675	600	400

A typical passenger coach built about 1906

A number of years ago some experiments were undertaken to determine the relative ability of two types of spot-welded low-alloy steel specimens to withstand a tensile loading. Type A and B specimens were identical except that Type B was subjected to a tempering. Spot-

De luxe lightweight coach in which welding has been used extensively



Typical underframe of a passenger coach of the late 1920's

weld specimens of each type were prepared and tested in the manner shown in one of the drawings. The applied load at failure for Type B was consistently greater than that for Type A and it failed in a more ductile manner.

An enlarged portion of the spot weld in the Type A specimen is shown in another drawing. Notice the very good weld structure and the heat affected zone surrounding the nugget. An examination of the heat affected zone revealed a very hard and quite acicular structure. The hard zone concentrated stress at the edge of the nugget and thereby caused failure at a relatively low external load. This type of zone was not so critical around the Type B nugget.

The results of this investigation emphasize the importance of properly stiffening thin spot-welded low-alloy steel side sheets against the formation of dynamic buckles in service in order to avoid tensile-fatigue failure.

At first, there was complaint about the formability of low alloy steels. While their general formability still holds room for improvement, we have become familiar with their characteristics. The steel companies have developed improved characteristics.

As a new product, alloy steels had their troubles and it was necessary to learn how to fabricate them. At one time the forming die cost attached to a car may well have been a considerable portion of the total but the proper application of welding has reduced this considerably. Compare the all welded bolster with flame cut diaphragms to the riveted bolster having pressed diaphragms.

For long steel shapes requiring accuracy, such as mouldings, either the draw bench or power rolls may be used. These methods are limited by the characteristics and thickness of the steel that may be economically formed.

Steel Castings

A properly designed weldment will generally weigh less than a steel casting. Thinner high tensile sections may be used than a good foundry practice will allow for casting walls. It may be that a combined weldment and casting should be employed to meet a given set of conditions.

Truck equalizers are expensive forgings. Some development is at present under way towards casting these in a high-tensile steel. If preliminary design bears out in the final result, there will be a considerable weight reduction. An item as critical as the equalizer will require strict quality control in the foundry, possibly either X-ray or magnaflux.

Magnesium is today little known outside of certain wartime industries but it is apparently being successfully used both structurally and otherwise. Due to low elastic modulus and strength combined with a somewhat higher cost, magnesium is not a satisfactory structural material for railroad rolling stock, but this metal with its light weight and suitability for extrusion can be employed for certain non-structural purposes in passenger cars.

Table IV—Comparison of Open-Hearth and Low-Alloy Steels

	Open hearth	Low alloy
Physical Properties		
Elastic modulus, lb.	30,000,000	30,000,000
Yield strength, lb. per sq. in.	32,000	50,000
Ultimate strength, lb. per sq. in.	60,000	70,000
Basic Design Stresses (lb. per sq. in.)		
Tension	16,000	25,000
Shear	10,000	15,600
Bearing	20,000	31,200

Magnesium does not form particularly well without application of heat but it is claimed that the forming temperatures will not affect its properties. Thin sections of magnesium constitute a fire hazard; the more finely divided material having the greatest potential hazard. Chips, turnings, grindings, drillings, etc., are a serious shop hazard and strict precautions must be taken for their proper collection and disposition.

Magnesium corrodes readily and should be thoroughly covered with a protective coating. Pockets that might entrap corrosive media must be avoided. Copper or alloys containing copper must not be allowed to contact magnesium. Steel rivets and screws should not be arbitrarily used to fasten this metal in place, particularly if corrosive media are present. However, steel screws can be plated so as to avoid a direct contact.

Aluminum in Car Work

The heat-treated and cold-worked classes of the wrought aluminum alloys holding our general interest are listed in Table VI. These alloys obtain their strength in the manner indicated by the column headings. Some of the heat-treated alloys may also be cold worked to increase their physicals.

Nature has bestowed upon aluminum some physical characteristics quite different from steel. The elastic modulus and unit weight are both about one-third those of steel. Heating either the cold-worked or the heat-treated alloy above certain temperatures will result in a loss of strength which cannot be recaptured without a re-heat treatment.

The alloys most commonly used in passenger equipment cars for non-structural purposes are 38, 52S and 53S; and for structural purposes are 17S and 24S with 17S the more predominate.

Table V—Typical Properties of Magnesium

Alloy	Weight, lb. per cu. in.	Elastic modulus, lb.	Yield, lb. per sq. in.	Ultimate lb. per sq. in.
Magnesium	0.065	6,500,000	27,000	42,000
Aluminum 17S-T	0.101	10,300,000	32,000	55,000

Table VI outlines the minimum ultimate and yield strength values of these alloys. Alloy 61S-T is included as one that cannot be used structurally in passenger cars because the spread between the ultimate and yield is less than that required by the A. A. R. A modified alloy, 61S-T62, is available with the spread increased sufficiently by reducing the yield to 26,000 lb. per sq. in. The 17S alloy has a yield comparable to open-hearth steel and the A. A. R. specification, therefore, permits designs using this alloy to be based on the published design stresses for open-hearth steel. The 24S-T alloy has higher physicals than 17S-T but does not form as readily and is at present somewhat more expensive.

Careful handling during fabrication and erection must be observed. The expansion coefficient is about twice that of steel and indiscriminate hot riveting may drive sufficient metal ahead into a blind end to form a buckle difficult of removal.

The A. A. R. Specification limits to 1 in. the deflection of a passenger car having approximately 60-ft. wheel base and under an 800,000 lb. buff applied onto the rear draft lugs. This restriction combined with the low elastic modulus of the aluminum alloys imposes a limitation on the structural weight saving.

Even though a higher-strength aluminum alloy were placed on the market in the postwar period, an analysis of the two preceding paragraphs will indicate that such an alloy cannot be economically used for outside structural sheathing or for any member affecting the deflection. However, this alloy would perform satisfactorily to reduce the weight of certain other structural members.

The effect of heat on the strength of the structural alloys has been previously remarked and this eliminates fusion welding in a member requiring maintenance of full strength. Non-structural alloys such as 3S or 52S can be readily arc, gas or spot welded. Spot welding of structural aluminum alloys is today practiced in the aircraft industry. The American Welding Society's Recommended Practice and the individual papers concerned with spot welding this metal generally stress two points; that extensive surface preparation is required and that the stored energy type of welding produces the soundest and most economical welds.

Published statements indicate that while the shear strength of the structural spot welds is satisfactory, their ability to carry appreciable tensile loads is not consistent. Spot welds in the structural alloys are particularly susceptible to corrosion and require protection.

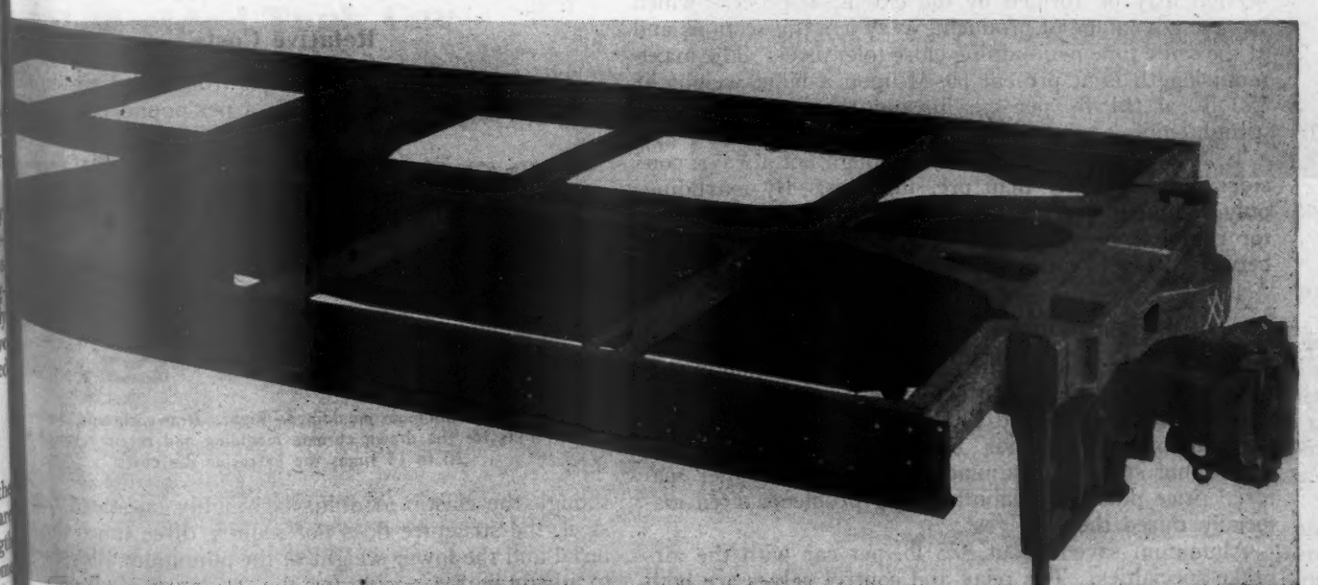
Aluminum Rivets

Although aluminum rivets are available in several different alloys, steel and A17S-T alloy rivets are the most satisfactory. The 17S-T alloy rivet possesses a greater strength than the A17S-T but its qualities are such that it must be heat treated and driven immediately thereafter or held at a very low temperature until used.

Table VI—Minimum Physical Properties of Heat-Treated and Cold-Worked Aluminum Alloys

Heat treated			Cold worked	
Alloy	Ultimate	Yield	Alloy	Ultimate
17S-T	55,000	32,000	2S-¼H to 2S-H	14,000 to 22,000
24S-T	62,000	40,000	3S-¼H to 3S-H	17,000 to 27,000
53S-T	32,000	25,000	52S-¼H to 52S-H	31,000 to 39,000
61S-T	38,000	35,000		

The strength of A17S-T rivets is appreciably less than for steel rivets and aluminum has a tendency towards corrosion in the presence of steel. Therefore, the choice of rivets will be influenced by the severity of both the load being transmitted and the conditions of corrosion. Providing the individual parts are properly primed and the completed structure thoroughly covered by a protective



Construction of welded underframe end in a modern lightweight coach

coating, there should generally be no reason to fear corrosion in the passenger coach. If containers holding brine solutions are loaded through dining-car vestibules, the splashing and resultant entrapment of some solution around connections will cause a materially accelerated corrosion, especially if exposed steel rivets are present.

Aluminum should not be allowed to contact any materials containing an appreciable amount of copper. Certain types of composition flooring and some glues must be

An enlarged portion of the spot weld in the Type A weld specimen shown in one of the drawings

specified to contain corrosion inhibiting agents. If reasonable precautions are taken, however, there will be no particular need for concern.

Formability

In general, aluminum alloys at full strength do not cold form as readily as steel. They have a tendency to crack unless a sufficiently large radius die is used but a low heat will improve this condition. The cold worked alloys may be selected of a temper to suit the severity of forming. The less the cold work the easier to form.

Shapes, structural or otherwise, of almost any cross section may be formed by the extrusion process which has the advantage of producing very lengthy sections and at the same time maintaining close tolerances. The maximum length is at present based upon a billet weight of 350 lb. at 0.1 lb. per cu. in. and the capacity of the straightening equipment.

Extrusion dies are very often, though not always, considerably less costly than pressing dies. By extruding, only one die is required for each part. The cost of rolls for complete mouldings and retainers sometimes varies between 10 to 14 times extrusion die costs.

Aluminum Car Specialties

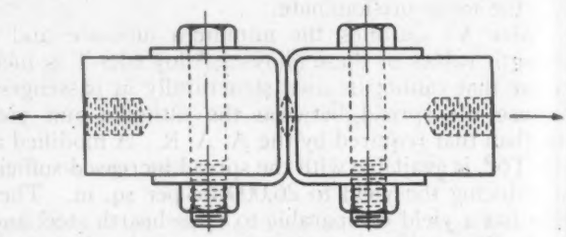
The specialties hold a field for further reduction in passenger-car weight and satisfactory results can be obtained with aluminum provided the cost is reduced to an economical cost-weight ratio. I have reviewed this problem with some specialty manufacturers and the higher material price plus new manufacturing problems often materially raised the final cost.

Aluminum saved about 875 lb. per car with the air-brake specialties. The relay and control valves are both intricate castings and passengers' lives depend upon their correct operation. Casting porosity must be avoided and accomplishing this plus the cost of aluminum advanc the price.

The price of an air distribution system was conside ably advanced due, it was claimed, to the increased m terial costs and the different manufacturing technique.

The rotating reclining seats afford an opportunity f a substantial reduction. With aluminum, various man facturers offered savings varying from 15 to 25 lb. p seat. For a 56-passenger car, this is a weight reducti varying from 420 to 700 lb. and from 600 to 1,000 l for an 80 passenger car.

The factor that aluminum presents in the reduction specialty weight will depend both on the ability of t specialty manufacturers together with the aluminum pr ducers to lower the selling price and on the over-



Tensile test specimens Types A and B are identical except Type B was tempered

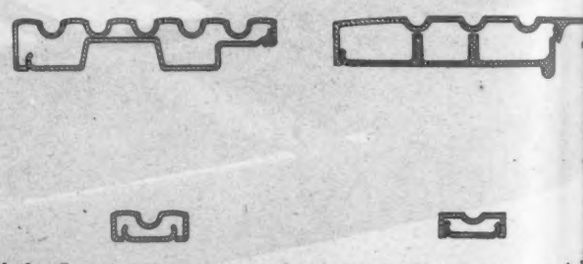
economy to the railroads. Neither the customer nor t manufacturer will consider absorbing the addition charges required to place practical and economical alum num specialties on the market.

We have reviewed aluminum and see that it has certa characteristics quite different from steel. The structu alloys are not presently weldable by the fusion proc and therefore assembly by riveting dominates. Pos bilities for corrosion must be observed when designi but need not concern us if certain fundamentals are k in mind.

Fast hot pressing, and other shop practices, quires high temperature heating of aluminum and the fore heat treating equipment. Whether or not it will economical to install this and other fabrication equipme will depend on the demand for railroad rolling sto fabricated from these alloys and that is a problem for producers of aluminum.

Relative Costs

The price of aluminum ranges from seven to ten tim that of the low-alloy steels on a per-pound basis. Ev



Left: Extruded aluminum mouldings—Right: Drawn chrome steel— cost of rolls for the drawn chrome moulding and retainer varied f 10 to 14 times the extrusion die costs

though the elastic modulus is roughly one-third that steel, the structure does not require three times the m terial and the lower weight of the aluminum alloys wor to advantage. Considering the structural shell only, proportionate total material costs in a passenger co may drop to a 3 or 2 to 1 ratio depending on the s

of the structure and the amount of steel present. The reflection of this ratio in the total cost is markedly reduced by the addition of specialty prices, labor, and operating expenses. In proportion, the cost of a freight car would be influenced considerably more than that of a passenger car. A detailed discussion concerned with the relative economy of aluminum and steel is particularly difficult because of the changing conditions of transportation facing us in the future.

Both original and maintenance costs contribute largely to the over-all economy of the structure. The previous discussion concerned with material cost indicated that proportionately the higher per pound price of aluminum would more strongly reflect in the total cost of a freight car than in that of a passenger car. Ability to withstand fatigue, corrosion, and hard usage are recognized maintenance factors which will affect this cost. Both the U. S. Steel Corporation and the Aluminum Company have had some hopper cars engaged in hauling coal under service tests for a number of years. Published statements at this time of the comparative results obtained with U. S. S. Cor-Ten and the aluminum alloy would be interesting.

Decline in Individual Orders

The size of individual freight-car orders has declined. Therefore, any inefficiency on the part of the car builder resulting from a material being difficult to fabricate, or from other causes, cannot now be as readily absorbed but will rather be more sharply reflected in the average cost figures. Efficient operation has to be maintained from the start of fabrication. Uniform materials of construction that meet these normal requirements of the industry for economical fabrication and assembly must be available.

The ability of either steel or aluminum to fit into this general picture as influenced by first cost, maintenance, revenue, etc., which may all be summed up as the cost-weight ratio over a specified period, will determine the degree to which each is used.

Swedish Railways All-Welded Tank Car

(*Continued from page 353*)

heads. The tank is in itself strong enough to support the load as well as to sustain all draw and buffer forces that must be reckoned with. For reinforcement the tank is braced on the inside in a serviceable manner, especially in consideration of the buffing forces to which the car may be exposed. The tank is made of steel plate which has a tensile strength of 52,500 lb. per sq. in. and it is hydraulically tested for a pressure of about 30 lb. per sq. in. The cars have a wheel base of 16½ ft. and 19 ft. 2¾ in. and overall lengths of 29 ft. 8½ in. and 32 ft. 4 in. respectively .

The cars are provided with a powerfully made draw gear at each end instead of a through draw bar. Standard freight-car coupler hooks are used for the cars intended for use on Swedish railways and the force is transmitted to the buffer beam by means of two standard volute buffer springs at each buffer beam. The entire draw gear is easily accessible from above. The buffers are of the socket type.

These cars are fitted with roller bearings and the supporting springs and suspension are of the type standard to Swedish freight cars. A screw-type hand brake which acts on all wheels through double brake shoes is operated with a crank wheel from a platform at one end of the car. In addition, some of the cars are provided with an air brake with a brake-gear changer and slack adjuster. The brake cylinder and reservoir are suspended in brackets which are welded directly to the tank. The total weight saving realized in these cars is about 4,400 lb.

Great Northern Plywood Box Cars

(*Continued from page 348*)

is hoisted and key-bolted in place at the first station inside the shop; then the car starts on its way.

The steel roofs are assembled on a special rack just above the floor, with a light traveler crane to carry the pinch riveter and another to carry the rivet heater. The assembled roof is picked up by two trolley hoists and put in place on the car ready for riveting.

Interiors of the Great Northern's plywood box cars are sprayed with varnish

The steel ends are stocked out of doors, and a traveler-crane is used to set them on the underframe, where they are set up, being reversed temporarily in order to clear the side sill at the first station. After the sides are set up, a station is fitted with a special hoist for properly setting up and key-bolting two steel ends, one on each car.

The progressive method of car assembly is used throughout. All material for each station is delivered and piled, completely finished and ready for use at that station.

EDITORIALS

Synthetics Which Increase Motor Ratings

The name Silicone has been given to a number of synthetic, thermal-setting, insulating resins and varnishes which may have a revolutionary effect on motor design. They establish a new class of electrical insulation which will raise safe operating temperatures of many types of equipment from the previous range of 105 to 130 deg. C. to a new range of 150 to 200 deg. C. Before they are baked and set by heat, they are good impregnants and afterward they form a mechanically strong bond between layers of material such as mica, glass fiber, cloth, asbestos, etc. Silicone insulation has the further merit that sparks or short circuits cause no carbon deposit and therefore do not result in tracking. It is also highly resistant to water and oil.

The most spectacular thing which has been done with Silicone is to produce a Silicone-insulated motor weighing 210 pounds which develops the same horsepower as a standard motor weighing 410 pounds. This is described elsewhere in this issue. The comparison is made with a motor having class A insulation, and the gain would be considerably less as applied to the railroads' number one problem of traction motors insulated with class B insulation which will withstand somewhat higher temperatures.

The limiting factor in all class B insulation is the varnish, and Silicone definitely raises the limits. One of the first things that will be done will be to rewind traction motors, when such rewinding becomes necessary, using Silicone varnishes. This should definitely alleviate some of the present troubles being experienced in the electric-traction and Diesel-electric traction fields and extend the life of motors now being overloaded to meet war traffic demands.

Later it may be possible to redesign and rerate traction motors. Theoretically at least, motors of the same horsepower could be built which would be smaller and lower in cost, but space limitations have always governed and will probably continue to do so. The net result will be more powerful motors.

If motors are to be operated at temperatures of 200 deg. C. or perhaps more, some precautionary measures will be necessary. At present the back coil connections on traction motors are brazed, while the commutator risers are soldered. The higher coil temperatures might easily cause solder trouble and it would appear that some way should be found to braze (silver solder) the riser connections as well. Also, in some designs of motors, enough heat might be conducted to the bearings to cause annealing of a babbitt bearing. As experience is gained, motors will be designed for use with the new insulations and it may be expected that direct benefit will accrue to all types of motive power using electric transmission.

How Important Is Locomotive Maintenance?

In times such as the railroads are now experiencing there is a tendency for one reason or another to feel that the work of our associations in the railroad field should be more or less of a side issue and that a railroad man should devote every hour of every day to the particular job for which he is paid. When one considers the importance of cooperative and coordinated effort in developing the means to improve railroad operations it is rather difficult to understand the attitude of a mechanical man who does not recognize that a contribution to the work of a technical association is an extremely important part of his obligation to the industry in which he serves and can be a very profitable contribution to the railroad which employs him.

Over a period of five or six years, the Locomotive Maintenance Officers' Association has been in the process of laying the foundation for an organization of railroad mechanical department men whose function it is to make sure that the motive power of American railroads is maintained at a high standard and in the shortest possible time.

It is worthwhile, again, to call attention to the fact that the money spent for the maintenance of railroad motive power—steam, Diesel and electric—represents the largest single item of expense in connection with railroad operation. This fact is of more than incidental importance because it not only shows the extent of a group of mechanical operations and personnel within the railroad industry that at one time during peace time represented a greater number of men and a larger expenditure in wages than the manufacturing plants engaged in producing automobiles, but because it does represent such a large expenditure it offers proportionately greater possibilities for effecting economies in maintenance methods.

In this industry within an industry there are approximately 2,000 to 2,500 men in official and supervisory capacity whose efforts are devoted to the servicing and maintenance of locomotives; who are responsible for formulating the policies with respect to maintenance and who recommend the character of facilities with which the work must be done.

In the field of the mechanical department, the L. M. O. A. represents one of a group of four associations the work of which in the car and locomotive field is related to and complementary to the work of the Mechanical Division of the A. A. R. With respect to motive power, the major part of the effort of several A. A. R. Mechanical Division committees is concentrated on the problems of design, utilization, and economics. Over a period of years almost no effort has been directed toward the problems of the shop and the enginehouse.

It seems rather difficult to explain why the L.M.O.A., representing as it does such a potentially important and profitable relation to railroad operation, should have any trouble in gathering into its membership a representative group of important mechanical officers and supervisors from every railroad of any consequence in the United States and Canada. Possibly the difficulty is that because of the fact that up to this time the association, while being sponsored at least by the A. A. R. Mechanical Division and having high mechanical officers on its advisory committee and in its membership, has been obliged to conduct its initial organization efforts and its campaign for members on an individual basis. It would be a fine thing if an association such as this could be built into a large and effective membership through the recognition on the part of interested individuals of the importance of its work, but in the five or six years of its existence it still has less than 250 members and does not have men representing many railroads in this country without whom the complete effectiveness of its work cannot be realized.

Possibly it is not out of order at this time to suggest that the time has arrived for mechanical officers to do some serious thinking about the potential value of an association such as this through the coordinated efforts of which the facilities and methods related to motive power maintenance can be effectively improved. It might help, in considering the matter, to mention again that the work of the Mechanical Division has for the most part been concentrated on the problems of design and standards and, over a period of years, the committees of that group have not dealt with shop or enginehouse facilities or methods except in an incidental manner. Such being the case, it is actually a fact that a large and important phase of the work of the mechanical department has been in a field left almost untouched by any organization except the Locomotive Maintenance Officers' Association.

At this moment the whole question of methods and facilities for the maintenance of Diesel electric motive power is in a state of flux. There is a mighty important job to be done by a group in the mechanical department in the matter of recommending to railway management the character of facilities and methods that should be developed for this new form of motive power. There is no better way of finding out how motive power should properly be maintained than to coordinate by means of committee work the knowledge and experience represented by the men on the railroads who are living with this problem every day.

If this be true, why is it that every important railroad interested in improving locomotive maintenance does not actually encourage a selected group of mechanical officers and supervisors to become members of this group and become active in the work of committees for the purpose of developing reports that may ultimately serve as guides for all the railroads in the matter of maintenance and incidentally to the Mechanical Division committees in the matter of changes in design as a result of maintenance experience?

These mechanical associations, such as the Locomotive Maintenance Officers' Association in which membership is purely voluntary, can not develop into effective technical groups as long as men below the rank of chief mechanical officer have any feeling that there may be doubt in their superior's mind as to the value of association work. Forward-looking mechanical officers owe it to their supervisors to let them know just where they stand on this matter of association work.

Bad Orders Threaten Adequate Car Supply

The first eight semi-monthly reports of 1944 car conditions showed an average bad-order ratio of 2.5 per cent. On an average of 1,713,121 cars on line this indicated that, at any given time, approximately 42,828 cars were out of service while undergoing or awaiting repairs. The last four reports, ending with the one dated June 15, show an average of 3.0 per cent in bad order. With an average of 1,717,293 reported on line the number of cars out of service had increased to about 51,519. The difference between these two figures, 8,691 cars, represents more than half the total number of new cars delivered during the entire first six months of the year. These deliveries totaled 17,183 cars.

It is readily apparent that any further increase in the number of bad-order cars which are undergoing or awaiting repairs will have a serious effect upon the serviceable car inventory of the country. Expected production of new cars for the entire year will hardly exceed 40,000 units. Each fractional increase in the number of bad-order cars serves to lessen the value of new car deliveries to the extent that they no longer represent a gain in total hauling capacity but serve only to hold ground in the transportation fight.

The adequacy of a bad-order ratio of 2.5 per cent in preventing gradual deterioration of freight cars has been questioned in these columns before. Four per cent is probably nearer the minimum requirement if the complete effects of wear and of "time and the elements" are to be restored currently. But if the bad-order percentage was to rise to four per cent before the end of the year, about 65 per cent of the expected gain in serviceable car supply from the delivery of new cars will have

been nullified because of the increased number of units out of service awaiting repair. So, car departments throughout the country must find some way in which to hold the percentage of bad orders down while still maintaining inspection and repair programs that provide needed safety factors.

That this may prove difficult of accomplishment in view of the manpower situation offers another challenge to the initiative of supervisory officers in assigning such forces as they have in the most effective manner and in adopting every labor-saving method and medium of which they can avail themselves. The progressive deterioration of many of the older cars will not make the task any easier but it must not be used as an excuse for failure to keep the bad-order percentage within a limit which will assure a true increase in carrying capacity from the new cars which are to be delivered.

Motive power supply is expected to be adequate for the foreseeable demands likely to be made upon it. The same statement can not be made concerning car supply with any such assurance. Car shortages in various types of equipment have been common during the first half of the year and any traffic increase in the last half can only result in more instances in which shortages will occur or will be more serious when they do occur.

Scheduling in the Locomotive Repair Shop

The organized scheduling of locomotive repair operations so as to secure orderly procedure, get material and repair parts ready when needed and turn locomotives out of shop in the minimum time consistent with the class of repairs, was instituted and a rather complete system installed at the West Albany, N. Y., shops of the New York Central, for example, by 1911. After some preliminary experience, the Boston & Maine installed a somewhat similar system at its Billerica, Mass., shops when these facilities were first placed in service in 1914. Other roads followed suit and in the ensuing years shop schedules, adapted to the varying requirements of different roads and different shop operating conditions, were quite widely installed. In general, the tendency was towards simplification and the elimination of unnecessary detail and it would be hard to evaluate the increase in shop production and resultant decrease in locomotive hours per classified repair accomplished by the orderly scheduling of operations.

The experience of the Southern Pacific in scheduling locomotive repairs was described in an interesting paper, presented by Starr Harris, schedule foreman at the Sacramento, Calif., shops, before the Pacific Railway club early this year. A simplified schedule system was installed at Sacramento early in 1924 and after a year's use, the average number of shopping days for Class 2 repairs dropped from 54 to 41; Class 3 from 31 to 26 days; and Classes 4 and 5 from 25 to 18 days. At the present time, with large power, only, handled at Sacramento general shops, the average number of working days per locomotive has been reduced to 26 for Class 2 repairs, 21 days for Class 3 repairs and 20 days for Class 4 repairs. In explanation of the small difference in time required for Class 3 and Class 4 repairs, it is explained that, except for flues, practically the same amount of work is performed on both classes.

Experience on the Southern Pacific, as on many other roads, shows the vital importance of a modern schedule system and, in most cases, it pays to have the master schedule board located at a prominent position out in the shop where it can be readily seen by supervisors and also by workmen, a surprising number of whom will show interest in how the work is progressing if they are given this opportunity. Departmental boards and schedule sheets giving the due dates for all important items of locomotive repair work are desirable and generally used, in most large shops at least, arrangements being made for all work completed on time to be so indicated and delays emphasized by some mark which shows the department or cause responsible for the delay.

Obviously weak departments and other sources of delay, whether lack of materials, machinery or manpower, are made quickly evident by the shop schedule system and corrective measures can be taken. The use of these schedule boards, when kept accurate and up-to-date proves very helpful in assuring a continuous flow of work through the shop, helping to avoid "bottlenecks" and conserving the time of all shop supervisors who do not need to visit other departments in order to make sure that repair work which has a bearing on their own operations is progressing favorably.

One of the greatest advantages of shop scheduling is the check which it gives on materials, enabling shortages to be brought to the attention of the stores department and focusing attention on this shortage until it is relieved. The success of shop operations is of course closely tied up with the experience, resourcefulness and ingenuity of stores department officers in anticipating needs and making sure that repair programs are not tied up for lack of materials, a goal by no means easy to achieve, especially under present conditions. In fact, mechanical and purchasing and stores department cooperation reach theoretical perfection when repair programs are not started until all necessary materials are on the ground or "in sight."

Shop schedule systems can never be worth the powder to blow them up without the full and hearty support of higher mechanical officers and especially the local shop managements. An elaborate system, more or less forced on a reluctant shop superintendent, or master mechanic, will never be anything but a formality and, at that, one which will not stand the test of time. On the other hand, with a progressive shop management and a schedule streamlined and simplified to meet local requirements, there is almost nothing which will prove of greater help to foremen in getting desired results.

With the Car Foremen and Inspectors

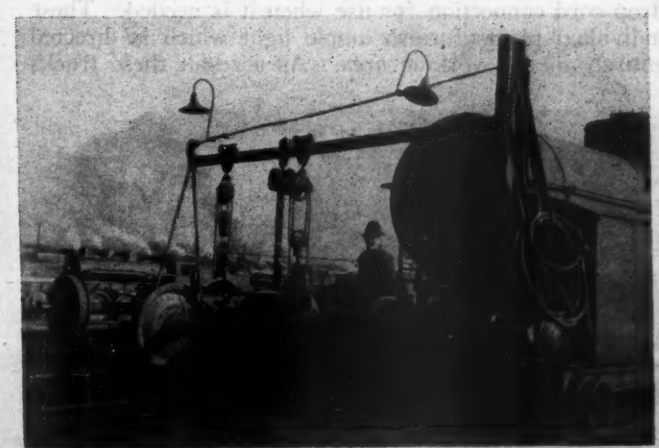
Southern Wheel-Change Track

Wheel changing arrangements on the freight-car repair track of the Southern at Spencer, N. C., have been worked out through cooperation between local supervision and management to a point where this work is handled speedily and economically. During recent years, with the heavy traffic moving through the territory where the track is located, wheel changes have been very numerous and it is felt that delays to cars would have been common if the track as it is now laid out had not been in operation. In addition, the facilities provided have made it possible to conserve manpower, a fact of great importance during the labor shortage. In March, 1943, for example, a crew of four carmen and two helpers changed 1,008 pairs of wheels.

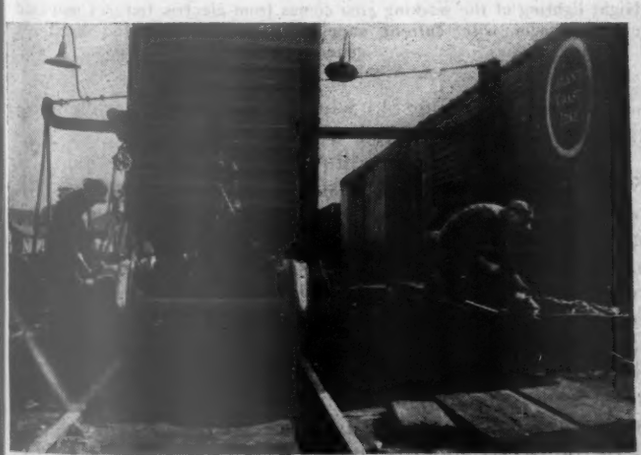
The track on which wheel changes are made is 600 ft. in length and is paralleled by a dummy track of the same length on which run the two service trucks which are the key to the efficiency of the set-up. These trucks have a boom built on them which is swung out over the repair track at the end of the car from which the truck is being removed. It is supported at its far end by an A-frame. Two 1½-ton and one 1-ton chain hoists are mounted on the boom for handling the side frames and the bolster. In this respect the servicing does not differ from the usual type A-frame commonly employed at car repair points. However, the ease with which the boom can be swung clear of one working spot and moved, with the truck, to the next location has done away with many

Mounted wheels are stored along the working track and moved to any desired location on a small hand cart which runs on the narrow track shown

The service trucks move on a wide gauge track



A locomotive headlight generator is driven by compressed air to furnish current for lighting of night operations



Three chain hoists are mounted on the swinging boom to handle the bolster and both side frames

Parts bins are stocked with materials needed by the wheel gang

of the inconveniences associated with moving the more commonly employed A-frames.

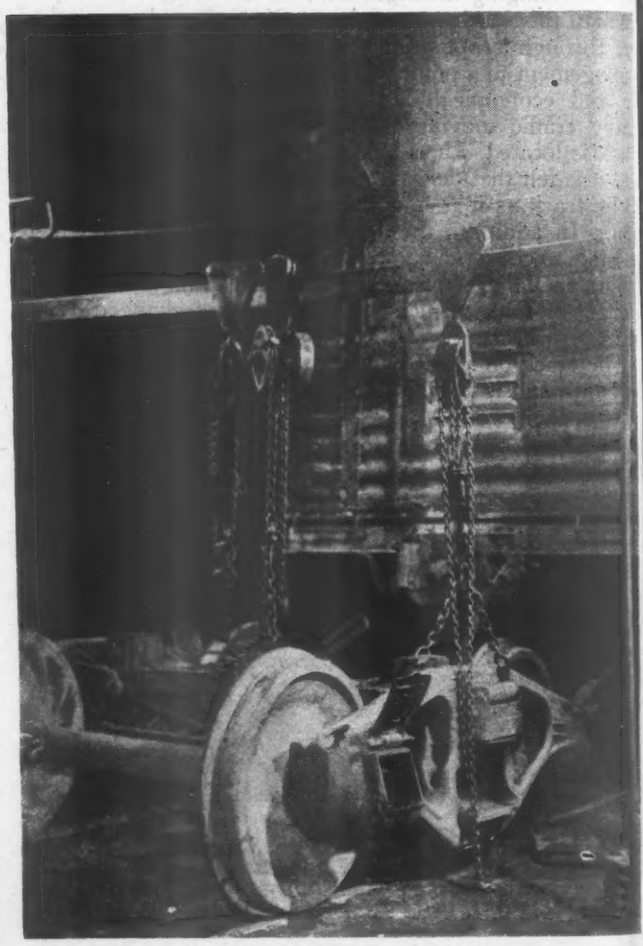
The trucks on which the booms are mounted are also moving storehouses as far as the wheel gangs are concerned. Bins in these trucks are stocked with all of the items which a wheel gang is likely to need, including dust guards and plugs, brasses and wedges, lubricating oil, oil for painting journals on wheels removed, brake shoes and keys, hangers, other miscellaneous items and small tools. There is also a record cabinet stocked with a Wheel and Axle Manual, the A. A. R. Rules of Interchange, a work record book and necessary report forms.

Each service cart is also equipped so that, when necessary, work can be done at night with current for illumination provided from generators removed from old locomotives mounted on the trucks. These generators are driven by compressed air from the yard lines. Two 150-watt lamps are mounted on the boom and there is a drop cord connection for use when it is needed. These individual plants furnish ample light which is directed entirely in the working area. As a result these trucks

Air-operated jacks speed operations and lessen physical demands on the workmen

are self-contained working units for either day or night use.

On the other side of the repair track from the dummy track on which the service trucks run there is a wheel-storage line, extending the full length of the repair track, which accommodates 66 pairs of mounted wheels, chilled-iron and steel, of various journal sizes. As needed, wheels are run off the storage spot onto a dolly cart which runs on a narrow track. The dolly carries the wheels to the working location where, as the new wheels are moved, the pair being removed is placed on the dolly. The old wheels are then moved to the wheel storage spot from which the new wheels were taken and are placed there to be picked up by a yard crane which services the entire



Night lighting of the working area comes from electric fixtures mounted on the boom with current supplied by an air-operated headlight generator

wheel line, removing old wheels and stocking each location with newly mounted wheels.

Each wheel gang is equipped with two air-operated 50-ton Joyce jacks for raising cars so that trucks can be removed from under them. Mounted on wheels, the jacks are readily maneuvered into position under the cars and are moved from spot to spot without difficulty. They replaced manually-operated jacks which often required four or five men on the jack handle when heavily-loaded cars had to be raised. Elsewhere throughout the yard the Southern has found it advantageous to furnish the latest styles of jacks of various manufactures and types to facilitate operations and reduce worker fatigue.

In the twelve months ending with February, 1944, the Spencer wheel track had changed out 10,078 pairs of wheels, an average of 840 pairs per month. This was

done with the force of four carmen and two helpers working on the day trick, with the exception of a comparatively small number changed at night on rush cars which had to be worked to meet connections. Under the present arrangement the helpers work with both pairs of mechanics, cleaning journals, obtaining wheels, coating journals on wheels removed and taking them to the storage location, and packing boxes. At no time is there need for great haste on the part of either pair of mechanics or of the helpers when the track is being worked in the routine manner. The physical benefit accrues to the workers because the facilities on the track are sufficiently complete that the hardest parts of the work are no longer performed manually. A workman, shown in one of the illustrations, who was entitled to retirement has been able to remain on the job because the physical strain of the work had been so far relieved that he can still perform a full day's work and do it efficiently. Such factors as this in addition to the increase in track production and the speed with which changes can be made when necessary have repaid the road for its attention to the laying out and equipping of this track. Similar arrangements are in use at a number of other points on the Southern but the Spencer installation was the first and is the most complete.

Bulldozer Jobs In the Car Shop

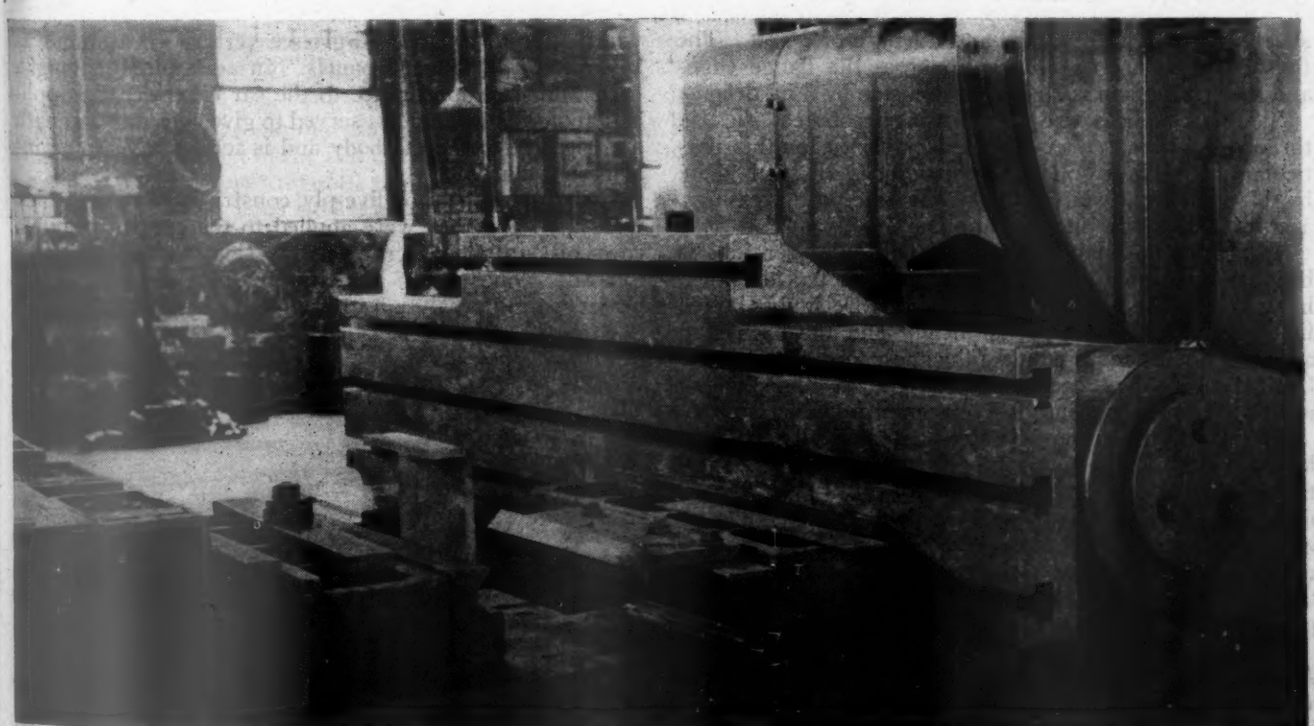
Quantity production of car parts produced by bending and forming has become essential to support present greatly stepped-up car-repair programs. At the Chicago car blacksmith shop of the Chicago & North Western such parts as pressed Z-bars, U-section side posts, freight-car spring planks, straight and taper passenger car floor girts, and numerous small pressings, such as side-post splices, passenger-truck center braces, and attachment

Ajax No. 10 bulldozer installed at the Chicago car blacksmith shop of the Chicago & North Western

pressings for the support of AB brake equipment, are being turned out on a large bulldozer.

One of the large jobs done in this manner is forming spring planks which are made of ⅜-in. O.H. steel 7 ft. 4 in. long by 17 in. wide, finished width. The channel flanges are bent cold in two operations, using a V-shape female die of the proper length on the back stop and a knife edge die bolted to the traveller or moving head. The production is about 160 channels in nine hours, which includes handling the incoming material to the machine and loading the finished spring planks on trailers for movement out of the blacksmith shop.

One of the illustrations shows the special back stop and the knife-edge die ready for setting up on the bulldozer for this operation. The back stop is of special interest because of its rigid construction and the fact that it is made at the local shop. Its overall dimensions



Special dies used in bending center braces for passenger trucks

are 10 in. by 12 in. by 10 ft. and it consists of two 1½-in. steel plates with end plates and ribs made of the same material, spaced about 10 in. apart and joined in a well-braced, rigid construction by electric welding. A light machine cut was taken on each of the long outside plates to assure the necessary uniform thickness and straightness of the back stop.

Side-post pressings are formed hot in one stroke. The original material consists of ¼-in. O.H. steel sheet sheared to a width of 11 in. and a length of 8½ ft. The finished posts are 6¾ in. wide across the flange edges and the box section is 2½ in. wide inside by 3 in. deep.

Side-post splices are made using cast-steel dies in three pairs which cover all necessary sizes for this particular job. These splices are made of O.H. steel ¼ in. by 11½ in. by 20 in. and, like the side-post pressings, are formed hot in one operation.

Typical of the many relatively small bulldozer jobs is bending the center brace for passenger-car trucks shown in another of the illustrations. The dies are simply bolted in the machine at the proper height and the back stop adjusted for the required plate thickness, one center brace being bent cold at each stroke of the machine, which means a potential output of seven center braces a minute.

To take up the driver-belt slack automatically the 300-hp. motor is mounted on a hinged bracket at the rear of the machine. Under heavy load this motor is free to move up and down with the hinged bracket, tending to maintain uniform belt tension at all times. As a precaution against damage to the motor and bracket in case the belt fails or slips off the pulleys, a stop has been placed under the motor-stop bracket to limit the fall.

The machine on which this work is being done is an Ajax No. 10 bulldozer, operating at seven 30-in. strokes a minute, which was installed in 1937. In using this large machine on small parts two sets of dies may be set up and operated at the same time.

Caboose Cars With Plywood Sheathing

Heavy freight traffic has required the Central Railroad of New Jersey to maintain in service a considerable number of steel-underframe, wooden-superstructure caboose cars. A number of these have recently been given heavy repairs at the Elizabethport, N. J., car shop during the course of which the old tongue-and-groove vertical sheathing was replaced with plywood panels. In addition to giving a better finished appearance to the car exterior, the application of the plywood has served to give a greater strength and rigidity to the car body and is felt to have some insulating values.

A 10-foot back stop and dies being assembled on the machine preparatory to setting it up for making freight-car spring planks

Four-foot panels of five-ply construction ¾ in. thick were used and they were applied to the car with double rows of 2-in. wood screws at the side sill, belt rail and top rail. The panels were tightly butt-jointed with a heavy coating of white lead used as a sealer and with the

Plywood panels are fastened to the side sills, and belt rail with wood screws

The ends of the cars are built of plywood and some cars have plywood linings on the interior

inside surface at the joints covered with several coats of an asphaltic paint to serve as an additional seal against the entrance of any moisture. On the outside the joints are covered with a 4-in. strip of 3/16-in. Flexiboard. Plywood was also used as inside lining on one of the cabooses undergoing repairs and its use may be extended for this purpose on others which are now in the shop.

Air Brake Questions and Answers

HSC High-Speed Brake Equipment for Passenger Cars and "A" and "B" Diesel Locomotive Units

259—*Q.—Describe the operation of this handle.* A.—The handle is inserted in the slot in the driver shaft housing *9* and pushed forward until the curved lip slips beneath cam roller *29*. This latches the handle to the driver shaft housing to which a keyway is pinned. The end of the shaft *95* is keyed to fit into the keyway so that the shaft turns with the handle. Plunger spring *18* acts upward on plunger *20* and roller *104* so that the handle is tilted upward, when not held down, and through pusher *22* unseats the pilot valve *21*, causing a safety control brake application. When the handle is held down the force of spring *18* is nullified, permitting the lighter spring *23* to seat the pilot valve *21*, closing the safety control pipe exhaust.

Independent Locomotive Brake

260—*Q.—What type of brake valve is used?* A.—The S-40-C which is a self-lapping brake valve by which the locomotive brake cylinder pressure is controlled by the position of the brake valve handle in the application zone.

261—*Q.—How does its self-lapping portion operate?* A.—Its self-lapping portion operates the same as that of the MS-40 brake valve previously described.

262—*Q.—How many connections has the pipe bracket?* A.—The pipe bracket has three connections; namely, No. 21, main reservoir supply; No. 20, independent application and release pipe which connects the brake valve to the application and release portion of the D-22-ER control valve, and No. 13 actuating pipe which connects the brake valve to the application and release portion of the D-22-ER control valve.

263—*Q.—How many positions has the brake valve handle?* A.—The brake valve handle has three positions from left to right (1) locking position; (2) release and running and (3) application position which includes the full application zone.

264—*Q.—How is independent release after electro-pneumatic or automatic operations obtained?* A.—By depressing the S-40-C brake valve handle.

265—*Q.—Can the brake valve handle be removed or replaced in any position?* A.—No. The handle can be inserted in or withdrawn from the slot in the driver shaft in release position only.

266—*Q.—How is release position indicated?* A.—Release position at the left is indicated by handle stop *4*, in which position the cam is at its lowest point, releasing pressure on dog *72*.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

No Charge for Repacking Boxes When Applying Bettendorf Truck Side

The Chicago & Eastern Illinois requested the Cities Service Oil Company to furnish a Bettendorf type truck side for repairs to car E. O. R. X. 6858 and after it was furnished and applied the railroad included an item of $3.70 for repacking journal boxes in its bill for repairs. The old repacking date was December 18, 1941, and the date of the billing repair card was September 30, 1942. Exception was taken to this billing and the railroad reduced its charge to $1.85 claiming that it was necessary to repack four boxes in applying a Bettendorf type truck frame. The Cities Service Oil Company contended that only two boxes required repacking and that the entire charge should be cancelled because the car was not yet due for periodic repacking. Its statement pointed out that when the spring plank and truck springs are removed, the truck bolster is lowered and the truck side can be pulled out over the end of the bolster and the car journals. In reapplying the truck side it is first set in place after which the bolster is raised and the spring plank and the springs reapplied. The railroad attempted to justify its charge by showing that the tripod device equipped with hoists which it used to expedite such changes and as a safety measure required disturbing the packing in all boxes on a truck.

In a decision rendered November 16, 1943, the Arbitration Committee stated, "It is unnecessary to remove the packing in the four journal boxes in order to remove and replace truck side in Bettendorf type truck. The contention of the Cities Service Oil Company is sustained." *Case No. 1799, Cities Service Oil Company versus Chicago & Eastern Illinois.*

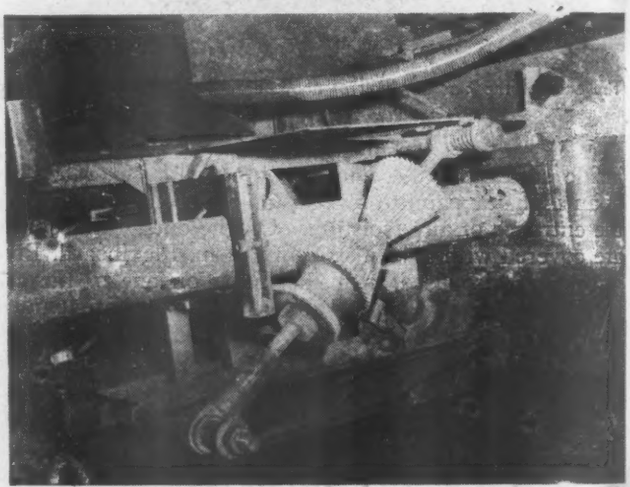
Erie Improves Hornell Flue Shop

In 1942 the Erie first placed in operation at Hornell, N. Y., a modern flue shop to handle the cleaning and reclamation of boiler tubes and flues for the entire system.* Since that time the shop has been visited by representatives of a number of other railroads interested in the results being obtained as a measure of what might be expected in the modernization of methods employed in this important maintenance work. Experience in its operation has led to the addition of a number of new devices and attachments which have further improved the quality of output and reduced the unit cost.

The cleaning of flue and tubes in the Wheelabrator,† which is really the heart of the layout, requires the use of large quantities of metal shot in the blasting cabinet. Some of this shot enters the ends of flues or tubes as they pass through the machine. Its recovery was possible, in the original set-up, only with considerable handling of each unit which involved both effort and expense. An alternative, the use of wooden plugs to seal the ends of flues and tubes before they entered the blast cabinet, was tried and abandoned because of the material and labor costs involved. The supervisor in charge of the flue shop developed an up-ending device which serves to clear all metal grit from each flue by gravity and which operates automatically. As a flue comes from the blast cabinet it goes onto a rack on which it rolls until it trips an electric switch which operates an air cylinder for raising one end of the flue and actuates a pneumatic tapper which jars the flue and aids the flow of grit into a receiving hopper. The entire operation is automatic with the flue being held in an elevated position for about 20 seconds. It is then lowered to the rack level and starts on its way down the rack toward the safe-end welder.

When flues are ready for the swedging operation, the man at the hammer operates a control which brings into play a rolling device which rotates the flue at a constant rate of speed while it is between the hammer dies. Formerly, the flues were rotated by hand but now a smooth even swedging is obtained with the use of the rotating device and the services of a helper are dispensed with at this working point.

The flue elevator and the rotating device at the swedger



Cracking rolls loosen scale before flues and tubes pass through the cleaning cabinet

Flue rotating device which eliminates manual turning of flues and insures even swedging

* The original installation was described in the December, 1942, *Railway Mechanical Engineer*, page 531.

† See *Railway Mechanical Engineer*, February, 1943, page 102.

Flue carriages have been motorized for movement between shop and erecting floor

have been the most important additions in contributing to efficiency but several other changes should also be mentioned. A scale breaker has been installed to loosen scale on flues before they enter the shot-blast cleaning cabinet. These are vee-shaped corrugated rolls placed above and below the flue and they can be adjusted according to the size of the flues being worked and the pressure which it is desired to apply, which is determined by the scale condition. The rolls are power-driven and the cracking action which they exert is such that all scale on flues can be removed on one pass through the cleaner.

Flue carriers used to bring bundles of flues into the shop and to remove them when they are being sent to the erecting floor have been motorized with power supplied through an extension cord. These heavy buggies were very difficult to move when fully loaded until the motors were applied.

Safe ends which are received coated with lacquer must be cleaned before they can be applied in the welder and this work is now done in a small tumbling barrel instead of by hand with sandpaper which was the method previously employed.

The changes mentioned have all contributed to a reduction in unit cost of reclamation and have also improved the quality of output. The elevating device and the swedging rotator are responsible for the greatest expense reductions. An appreciable quantity of metal shot is now reclaimed for further use. Recovered shot and dust is delivered to a hopper where a dust suction pipe connected with the suction chamber of the flue cleaner removes the dust. The shot as cleaned is ready for reuse and the value of reclaimed shot alone has already repaid the cost of the necessary installation.

This plant of the Erie is being studied constantly with an eye to still further improvements although the changes mentioned appear to have taken care of the more important needs found in the original installation.

Flue elevator employed to clear shot from the inside of the flues—Shot recovered is cleaned and reused

Locomotive Boiler Questions and Answers

By George M. Davies

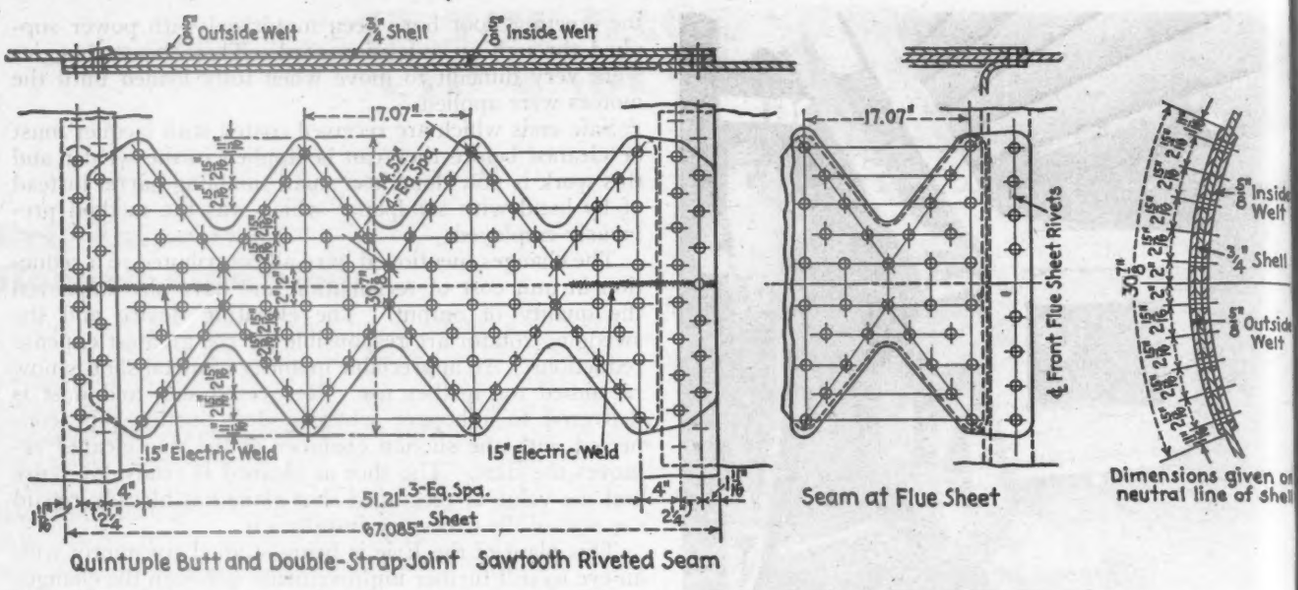
(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Sawtooth Seams

Q.—How is the efficiency of a sawtooth seam obtained? What are the reasons for employing this type of seam in place of the conventional quintuple butt seam?—D. V.

A.—In designing longitudinal boiler seams for locomotives which operate at working pressures from 250 to 300 lb. per sq. in. where weight restrictions of the boiler are close and where it is necessary to have a good tight seam due to high boiler pressure, a butt and double-strap-joint sawtooth riveted seam has distinct advantages. Some of the advantages of this type seam are as follows: The design is the same for inside and outside welt straps, which provides a good caulking space, due to the spacing of rivets, eliminating leakage at the seam; it decreases the weight of the welt straps over the conventional and diamond butt and double strap seams; it eliminates the buckling of the inside welt strap, such as occurs on conventional type butt and double strap quintuple riveted seam, where the rivet spacing in the outer row of rivets is large, when driving rivets on a bull riveter; it is easy to fit the welt straps to the boiler shell insuring that straps will be up tight before riveting; the welt straps are smaller in width than on a quintuple riveted butt joint or diamond seam and take less room on the boiler shell.

The method of calculating the efficiency of a quintuple-riveted butt joint sawtooth seam is as follows. This joint may fail in the following ways:



Sawtooth design of riveted seam for longitudinal joints of locomotive boilers

1—Tearing of the plate between the rivet holes in the outside row.

2—Tearing of the plate between the rivet holes in the second row and shearing one rivet in double shear in the first row.

3—Tearing of the plate between the rivet holes in the third row and shearing two rivets in double shear in the second row and one rivet in double shear in the first row.

4—Tearing of the plate between the rivet holes in the fourth row and shearing three rivets in double shear in the third row, two rivets in double shear in the second row and one rivet in double shear in the first row.

5—Shearing 14 rivets in double shear in the first, second, third, fourth and fifth rows.

6—Tearing of the plate between the rivet holes in the second row and crushing the welt straps in front of one rivet in the first row.

7—Tearing of the plate between the rivet holes in the third row and crushing the welt straps in front of the two rivets in the second row and one rivet in the first row.

8—Tearing of the plate between the rivet holes in the fourth row and crushing the welt straps in front of the three rivets in the third row, two rivets in the second row and one in the first row.

9—Crushing the plate in front of eight rivets in the fourth row and fifth row, three in third row, two in second row and one in the first row.

10—Tearing of the plate between the rivet holes along the diagonal row of rivets. The following formulas are used to calculate resistance to failure:

$$1\text{—}E = \frac{(P - D) \times TS \times t}{P \times TS \times t}$$

$$2\text{—}E = \frac{(P - 2D) \times TS \times t + A \times S}{P \times TS \times t}$$

$$3\text{—}E = \frac{(P - 3D) \times TS \times t + 3A \times S}{P \times TS \times t}$$

$$4\text{—}E = \frac{(P - 4D) \times TS \times t + 6A \times A}{P \times TS \times t}$$

$$5\text{—}E = \frac{14A \times S}{P \times TS \times t}$$

$$6\text{—}E = \frac{(P - 2D) \times TS \times t + 2\,(D \times B \times C)}{P \times TS \times t}$$

$$7\text{—}E = \frac{(P - 3D) \times TS \times t + 2\,(3D \times B \times C)}{P \times TS \times t}$$

$$8\text{—}E = \frac{(P - 4D) \times TS \times t + 2(6D \times B \times C)}{P \times TS \times t}$$

$$9\text{—}E = \frac{14D \times t \times C}{P \times TS \times t}$$

$$10\text{—}E = \frac{(L - 4D) \times TS \times t}{P \times TS \times t} \times K$$

A typical sawtooth riveted seam is shown. The efficiency of this seam is obtained as follows using the following values:

E = efficiency.
TS = 55,000 lb. per sq. in., tensile strength of plate.
t = 3/4 in. = 0.75 in., thickness of shell plate.
B = 5/8 in. = 0.625 in., thickness of welt straps.
P = 17.07 in., pitch of rivets on row having greatest pitch.
D = 1-5/32 in. = 1.15625 in., diameter of rivet after driving.
A = 1.05 sq. in., cross-sectional area of rivet after driving.
S = 88,000 lb. per sq. in., shearing strength of rivet in double shear.
C = 95,000 lb. per sq. in., crushing strength of plate.
L = 14.52 in., length of diagonal row of rivets.

$$K = \frac{2}{\sqrt{3} \times \sin Y^2 + 1}$$ Constant allowed for diagonal row of rivets, or 1.401

Y = 0.5887, sine angle 36 deg.

Inserting these values in the foregoing formulas we have:

$$1\text{—}E = \frac{(17.07 - 1.15625) \times 55{,}000 \times 0.75}{17.07 \times 55{,}000 \times 0.75} = 93.2$$

$$2\text{—}E = \frac{(17.07 - 2.3125) \times 55{,}000 \times 0.75 + 1.05 \times 88{,}000}{17.07 \times 55{,}000 \times 0.75} = 99.5$$

$$3\text{—}E = \frac{(17.07 - 3.46875) \times 55{,}000 \times 0.75 + 3 \times 1.05 \times 88{,}000}{17.07 \times 55{,}000 \times 0.75} = 119$$

$$4\text{—}E = \frac{(17.07 - 4.625) \times 55{,}000 \times 0.75 + 6 \times 1.05 \times 88{,}000}{17.07 \times 55{,}000 \times 0.75} = 151$$

$$5\text{—}E = \frac{14 \times 1.05 \times 88{,}000}{17.07 \times 55{,}000 \times 0.75} = 183.7$$

$$6\text{—}E = \frac{(17.07 - 2.3125) \times 55{,}000 \times 0.75 + 2 \times 1.15625 \times 95{,}000}{17.07 \times 55{,}000 \times 0.75} = 117.5$$

$$7\text{—}E = \frac{(17.07 - 3.46875) \times 55{,}000 \times 0.75 + 2 \times 3 \times 1.15625 \times 95{,}000}{17.07 \times 55{,}000 \times 0.75} = 173.2$$

$$8\text{—}E = \frac{(17.07 - 4.625) \times 55{,}000 \times 0.75 + 2 \times 6 \times 1.15625 \times 95{,}000}{17.07 \times 55{,}000 \times 0.75} = 260.1$$

$$9\text{—}E = \frac{14 \times 1.15625 \times 0.75 \times 95{,}000}{17.07 \times 55{,}000 \times 0.75} = 163.7$$

$$10\text{—}E = \frac{(14.52 - 4.625) \times 55{,}000 \times 0.75}{15.52 \times 55{,}000 \times 0.75} \times 1.401 = 95.4$$

Efficiency = 93.2 per cent.

Holder for Mounted Driving Wheels

Locomotive tire work at the Spencer, N. C., locomotive shop of the Southern is facilitated by the use of revolving holders which accommodate a pair of wheels during the time required for the removal of tires or their application to wheel centers. These holders use a cut-off car axle as a standard on which a V-type holder is mounted on a ball-bearing race. The car wheel is left on the portion of the axle buried in the ground with both the wheel and a portion of the axle embedded in concrete. The use of the ball bearings makes this fixture so free in movement that one man can easily rotate the entire wheel and axle assembly into any desired position.

Revolving holders mounted on ball bearings accommodate mounted driving wheel centers while tires are removed and applied

Fewer Cutter Teeth Speed Milling Operations

*By Fred W. Lucht**

In milling steel with cemented carbides, one of the most important considerations is the selection of the correct number of teeth on the cutter. Since increased cutting speed means more cubic inches of metal removed per minute and therefore greater power consumption it frequently becomes necessary—due to power limitations—to reduce the load in some manner. It usually proves to be better practice in such a case to reduce the number of cutter teeth rather than either the feed or the cutting speed. Maintaining sufficient feed per tooth is important in steel cutting—particularly in roughing—to provide both sufficient tooth loading and adequate load distribution back of the cutting edge.

This is illustrated by a typical milling operation on steel parts. The job concerned the milling of master connecting-rod steel forgings by 6 in. dia. inserted-blade face mills having 14 cemented-carbide-tipped blades.

The 6 in. dia. cutters used were standard type face mills operated at a peripheral speed of about 400 ft. per min. and with a feed of .0015 in. per tooth. After milling about 10 connecting rods, the cutting edges were chipped badly, several of the cemented-carbide tips being in such a condition as to make desirable the installation of new blades. This meant that after the damaged blades were replaced, the blades had to be re-set in the proper relation to each other and extra time had to be spent in grinding to put the cutter in good working order.

An examination of the less damaged cutter teeth showed that the light feed per tooth which was being used had increased the width of the "wear land" behind the cutting edges sufficiently so that the increased pressure due to dulling of the cutting edges was beginning to cause portions of the cutting edges to chip out.

In an attempt to increase production per grind and to cut down the time spent in repairing the damaged cutters, every other tooth was removed from each cutter. The remaining seven teeth were then resharpened exactly as they had been previously, an operation requiring a relatively shorter time than before. The same speed in feet per minute and the same table travel in inches per minute were used in these trials as had been employed previously. This, however—due to the number of teeth which had been removed—resulted in a feed of .003 in. per tooth rather than the original feed of .0015 in. per tooth.

The increase in feed per tooth enabled the cutters to machine some 30 connecting rods per grind instead of the previous total of 10. On inspection, the cutters showed merely a normal dulling of the teeth. No chipping of the cutting edges and no broken teeth were in evidence. The teeth required only a slight touch up with a diamond-impregnated grinding wheel.

Furthermore, with this change only three face mills per machine were needed to keep the operation going, one cutter being on the milling machine; one at the milling machine ready to be used; and the third in the grinding room being re-sharpened.

* Engineer, Carboloy, Inc., Detroit, Mich.

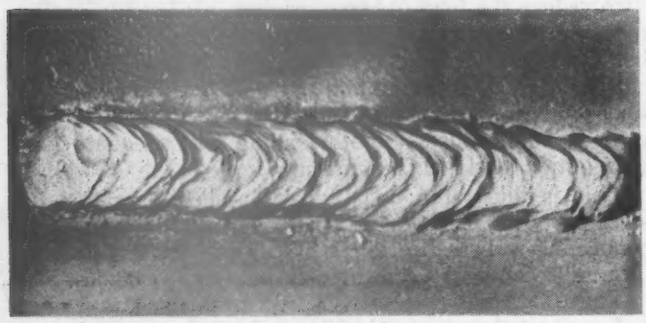
Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Surface Appearance of Welds

Q.—Does poor surface appearance necessarily mean that a weld is not good?

A.—No, it does not but it is evidence of conditions which should be corrected and inspection of such welds is more likely to disclose faults than in cases where a good



Courtesy Westinghouse Electric & Mfg. Co.

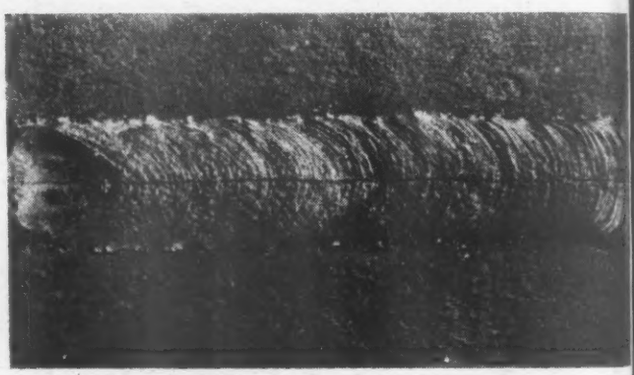
Weld with poor surface appearance caused by excessive welding current and improper weave

surface appearance is present. Poor surface appearance may be a sign of the use of improper current and arc voltage; of overheated work; of poor manipulation of the electrode; or, of electrode characteristics. In general, poor surface appearance can be avoided and a sound weld obtained by studying the characteristics of the electrode being used and insuring the use of the proper welding technique for it. Excessive currents should be avoided and welding should proceed using a uniform weave or rate of travel at all times. Overheating of the work should be avoided.

Cracked Welds

Q.—We have been welding some fairly heavy plate material lately but find that many of our welds show evidence of cracks. The work is being done in jigs. Can you suggest what our trouble might be?

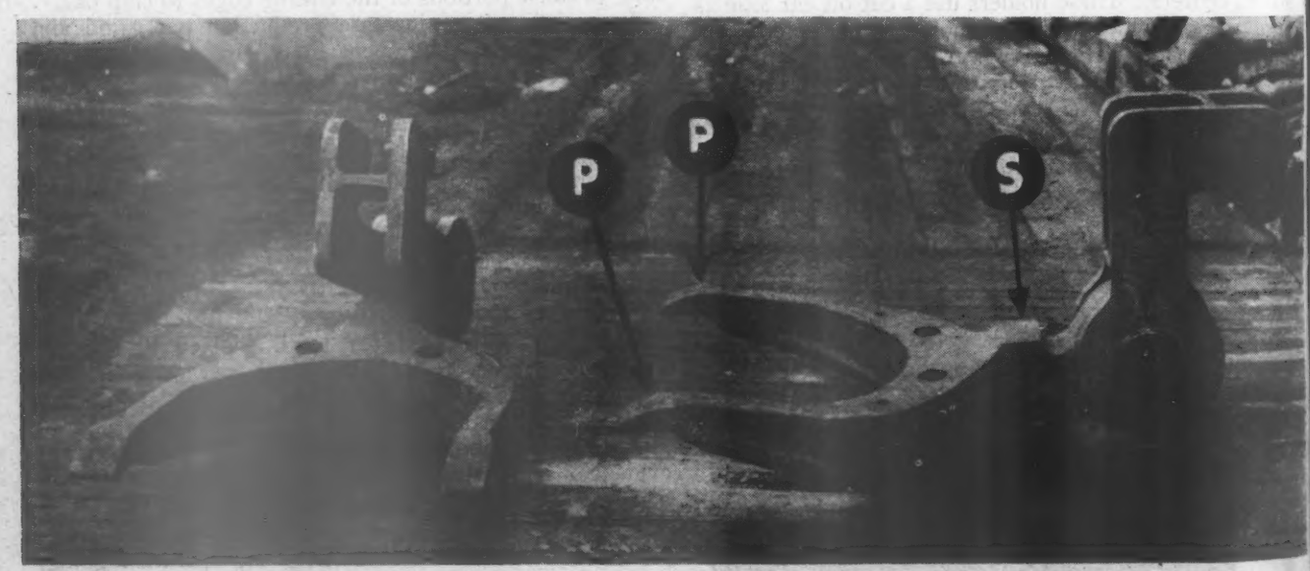
A.—Assuming that your welders are experienced and that your joint preparation and selection of electrodes are correct it seems likely that your difficulties come from one of two causes. It may be that you are holding the parts to be joined too firmly in the jig and not making sufficient allowance for movement; or, that the welds you are making are too small for the sections of plate which you are joining; or, that your design is wrong. Check your design to make certain that you can develop a welding procedure which will eliminate rigid joints. If you are using string beads of welding, try changing to full size welds in short sections of about 8 in. to 10 in. Increase the size of your welds because it may be that you are using too small a weld for the size of your sections. Study your welding procedure and jig clamping so as to leave the ends of the pieces on which you are working free to move as long as possible.



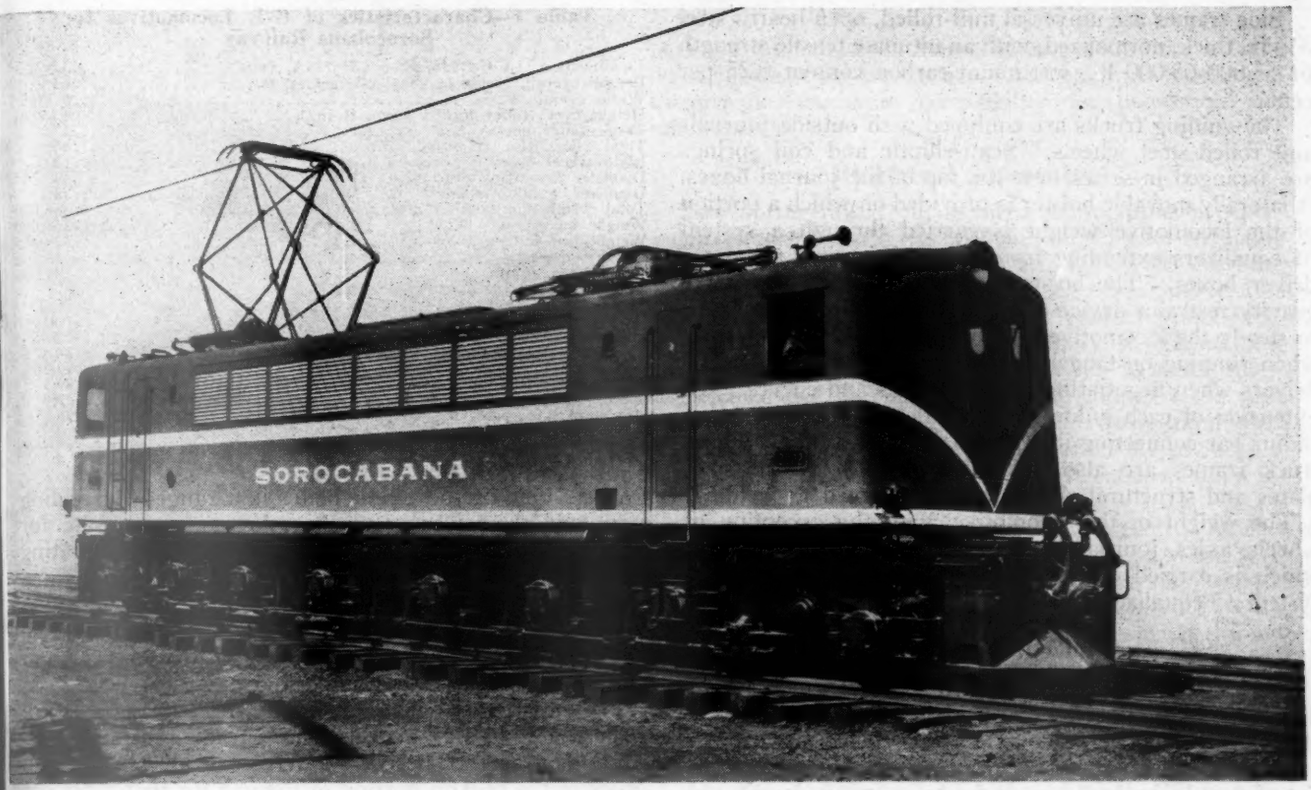
Courtesy Westinghouse Electric & Mfg. Co.

Cracked weld caused by rigid joint

* * *



Special type of lifting lever designed for use with either a shop crane or the wrecker in lifting Electro-Motive Diesel freight locomotives without damaging the superstructure—The yoke straddles the body bolster, with the two prong end *PP* resting on top of an intermediate underframe channel and having small bearing surface *S* in contact with the jacking pad provided under the side sill—Side lifting bars of the shop crane or wrecker engage the heavy hooks shown and can be used to lift either one end or the entire locomotive as required.



Electric Locomotives for the

Sorocabana of Brazil*

By R. L. Chapman and O. K. Kjolseth†

Meter gauge locomotives developing 2,000 hp., with regenerative braking, fill all main-line motive-power requirements

THE Sorocabana Railway of Brazil, S. A., in inaugurating electric traction on its extensive meter-gauge system has selected the 87-mile double track section between Sao Paulo and Santo Antonio in the State of Sao Paulo, Brazil, for the initial electrification.

Twenty locomotives are being furnished to handle passenger, freight, and mixed trains with scheduled speeds of 35 m.p.h. for passenger, and 30 m.p.h. for freight and mixed trains over a mountainous terrain involving maximum grades of 2 per cent, and prevailing minimum radius curves of approximately 800 ft.

These locomotives are the largest and most powerful 3,000-d.c. meter-gauge units built to date, and are among the outstanding examples of design and construction embodying all welded fabrication of mechanical parts and assemblies for main-line passenger and freight locomotives. Ten are being furnished by the General Electric Company and ten by the Westinghouse Electric & Manufacturing Company, with the mechanical portion of all twenty built by the General Electric Company. In addition to the mechanical portions which are identical much of the equipment as furnished by the two companies is either identical or physically and electrically interchangeable. Pantographs, traction-motor blowers, watt-hour meters, and high-speed JR circuit breakers are identical with all pantographs manufactured by the Westinghouse Company, and all breakers manufactured by the General Electric Company. Traction motors and motor-generator blower sets are interchangeable.

Running Gear

The running gear consists of two three-axle driving trucks and two single axle radius-bar guiding trucks.

The driving-truck frames are articulated at their inner end by a ball joint arranged to permit angular movement in both vertical and horizontal planes. The outer ends extend over the guiding trucks and carry draft gear, coupler, and pilot. The frames are fabricated of steel plates and structural shapes throughout with all parts torch-cut to size requiring little or no machining.

* Abstract of a paper presented June 30 at the Summer Meeting of the American Institute of Electrical Engineers, St. Louis, Mo.

† General Electric Company, Erie, Pa.

Side frames are universal mill-rolled, open-hearth steel 3½ in. thick, normalized, with an ultimate tensile strength of 55,000-65,000 lb., maximum carbon content 0.25 per cent.

The guiding trucks are equipped with outside journals and rolled-steel wheels. Semi-elliptic and coil springs are arranged in series over the top of the journal boxes. A laterally movable bolster is provided on which a portion of the locomotive weight is carried through a system of equalizers extending from the springs over the outer driver boxes. The bolster is provided with a variable gravity restraint device of relatively high initial restraint to steady the locomotive and minimize lateral oscillations when running on tangent track, and to assist guiding of drivers when negotiating track turnouts and curves. An extension of each guiding-truck inner frame serves as a radius bar connecting it to the main truck frame. These truck frames are also fabricated from torch-cut steel plates and structural shapes readily adapted to welding.

The weight of the locomotive, with the exception of wheels, axles, journal boxes, and that part of the motors which is carried directly on the axles, is carried on a system of equalized semi-elliptic and coil springs.

Cab Underframe

The cab underframe or platform is constructed of commercial steel shapes, bars, and plates. The structure is about 54 ft. long by 9 ft. wide. The center sills, which are the main load-carrying members of the frame, consist of two 18-in. by 12-in. H-beams reinforced with top and bottom plates of ½-in. thickness, forming a central duct serving as a pressure chamber into which air is discharged from two motor-operated blowers. From this chamber ventilating air is distributed to traction motors, accelerating resistors, and other electrical apparatus. Side and end sills are made of 8-in. standard steel channels. Bolsters supporting center plates, side bearings, and lifting lugs are rigidly tied into center- and side-sill members. The 18-in. sill members extend well beyond the bolsters, and are joined with 8-in. H-beams extending to the ends of the frame.

Cab

The cab is of semi-streamline design and is carried on two center plates located one on each of the two driving trucks. One of the center plates is arranged for sliding motion in the lower or truck socket to compensate for variations in truck center-plate distance when operating on curved track. Additional supports are provided through four spring-cushioned loading pads slideably supported, one on each side of each driving truck. The loading pad springs are calibrated to give the desired load distribution on all driving and guiding wheels.

The cab consists mainly of exterior sheets 0.180 in. thick welded to a 4-in. steel channel frame erected on the cab underframe. There are louvres provided in the side sheets of the central portion of the cab for ingress of air to the motor-blower sets. Large hatch openings in the roof which facilitate installation and removal of apparatus are closed by means of bolted-down hatch covers.

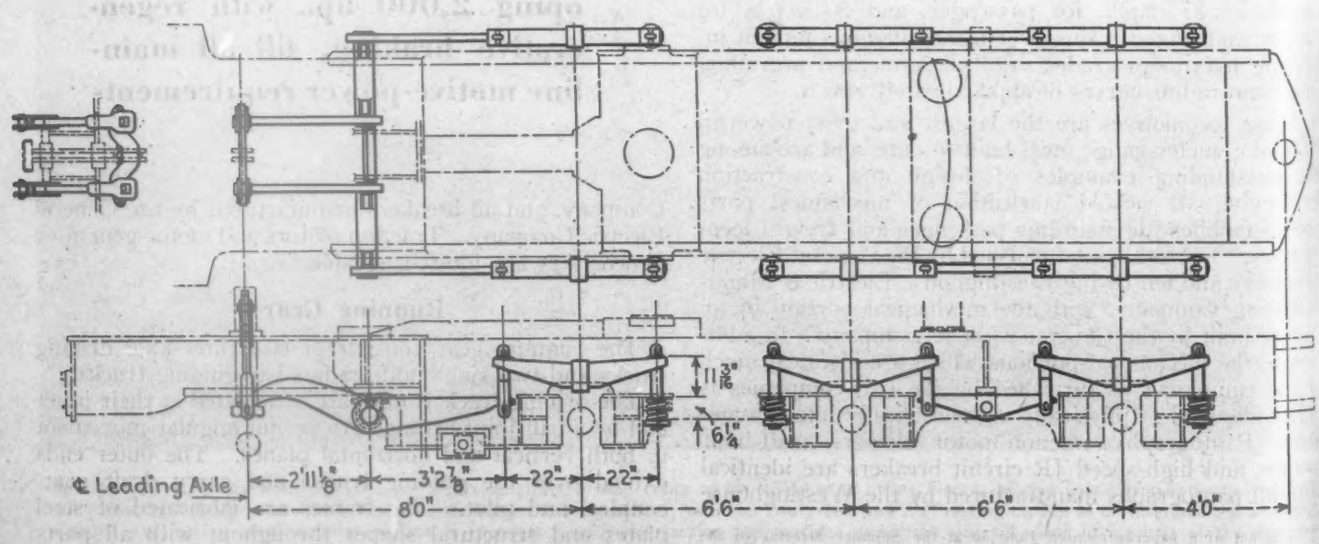
The apparatus compartment is built as a separate unit to facilitate easy installation of control apparatus and wiring. After the installation of apparatus and wiring is complete, the compartment is lowered through the hatch opening in the cab, and is securely welded to the underframe and roof structure.

Table I—Characteristics of G-E Locomotives for Sorocobana Railway

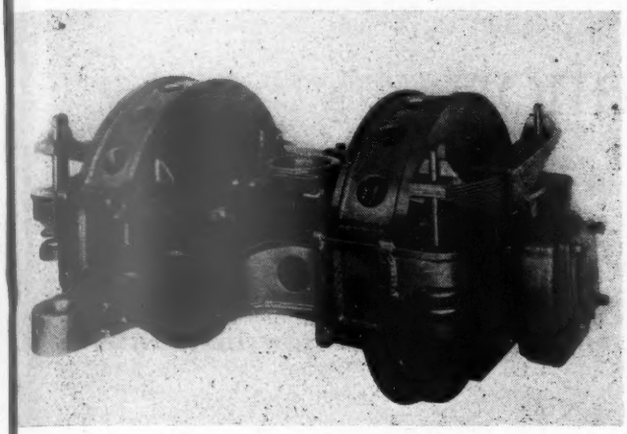
Classification, I-C-C-1-238/286-6 GE 734A, volts	3,000
Length overall, inside of coupler knuckles, ft.	61
Width overall, ft.-in.	9-7⅞
Height over trolley locked down, ft.-in.	13-7 1/16
Track gauge, meter	1
Total wheel base, ft.	50
Rigid wheel base, ft.	13
Diameter driving wheels, in.	44
Diameter guiding wheels, in.	33
Total weight in running order, lb.	286,000
Weight on drivers, lb.	238,000
Weight per driving axle, lb.	39,666
Weight on guiding axles, lb.	48,000
Weight per guiding axle, lb.	24,000
Number of motors	6
Gear ratio	75/17
Continuous rating, hp.	1,910
One-hour rating, hp.	2,195
Continuous tractive force, lb.	24,475
One-hour tractive force, lb.	29,500
Speed, continuous rating, m.p.h.	29.3
Speed, one hour rating, m.p.h.	27.9
Maximum safe speed, m.p.h.	56

Construction Details

The locomotive design throughout incorporates fabricated sub-assemblies which are easily handled for operations on the individual parts before being welded together for the complete assembly.



Spring and equalizer system



One of the two guiding trucks

All crosstie plates fitting between side frames are machined to length with ends squared and are welded into sub-assemblies to facilitate the easy setting up and squaring of the main truck frames. Each side frame, the articulation or inner end frame, the main-frame extension and other similar groups of parts are likewise fabricated to form finished sub-assemblies before final assembly together. The boring of the recess for the cab center plate in the middle crosstie and also the boring of the inner end frames for the articulation is performed in the subassembly stage.

After the truck frame is otherwise assembled and welded, pedestal shoes, forming guides for journal boxes, are set to position in a special fixture. Shoes are accurately trammed to position for squareness and distance, laterally as well as longitudinally, to the frame centerline extending through articulation, cab center plate, guiding truck radius bar fulcrum and center plate, draft gear and coupler. After accurate adjustments are accomplished the shoes are welded rigidly to the pedestal brackets.

The cab sides, together with the cab frame, the hatches, cabinets, and compartments, are likewise first fabricated as sub-assemblies after which they are set up and assembled with the cab platform which is itself a complete sub-assembly.

Air-Brake Equipment

The air-brake equipment is a combination of vacuum and compressed-air systems with the locomotive brakes operated by compressed air and the train brakes operated by vacuum. The locomotive brakes may be operated independently of the train brakes, or in conjunction with them, in which case the train vacuum system acts as a pilot for the locomotive air-brake system. Two 12-in. by 12-in. brake cylinders on each truck apply the brakes on that truck through a single brake shoe on each driving wheel. Interlocking prevents simultaneous operation of air brakes and regenerative braking to avoid the possibility of wheel sliding during regenerative braking.

Location of Apparatus

The space between the operator's cabs is divided into three sections. The apparatus compartment, completely enclosed but with access doors and with removable covers along the aisles on each side, is in the center, while auxiliary apparatus such as motor-generator-blower sets, compressors, exhausters, and air-brake control devices are located at each end. The operator's cabs at each end of the locomotive are separated from the apparatus compartment by bulkheads with a door opening onto an aisle on each side of the locomotive. All apparatus is arranged to provide maximum accessibility for inspection and maintenance.

Electrical Apparatus

Two spring-raised, air-lowered pantographs are provided, either of which has adequate capacity for collecting total locomotive current from the 3,000-volt overhead line. The pantographs are equipped with anti-friction bearings and each has two separate contact shoes, independently hinged, to assure flexibility in maintaining contact with the overhead contact wire. A small reservoir which can be charged from the control air system supplies air pressure for unlatching the pantograph when both pantographs are down and no other air pressure is available on the locomotive. A small hand-operated air pump is also available for this purpose.

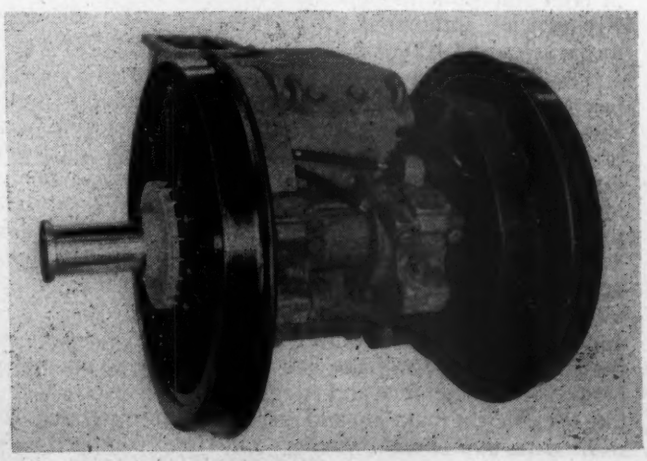
The two pantographs are connected together through a cable mounted on insulators on the roof and to the main power circuits through the protective devices mounted in the apparatus compartment in the main cab.

The traction motors are wound and insulated for operation two in series on 3,000 volts and are of the commutating-pole, force-ventilated type with anti-friction bearings. Axle-suspension bearings are waste packed, oil lubricated. The drive consists of single-reduction gearing with a pinion on the motor shaft engaging a solid gear on the axle, both being enclosed in a gear case which also serves as a reservoir for the gearing lubricant.

The motor circuits are arranged for three combinations of motors: six in series, three in series with two such groups in parallel, and two in series with three such groups in parallel. Accelerating steps, one full-field, and two reduced-field running steps are provided for each motor combination, thus making a total of nine running steps in motoring. Regenerative braking is available for each of the three combinations of motors.

The auxiliary equipment duplicates that previously used on locomotives for the Paulista Railway, and consists of two 3,000/65-volt motor-generator-blower sets, two 65-volt exhausters, and one 65-volt compressor. Each motor-generator-blower set consists of a single-commutator, series wound, commutating pole, 3,000-volt motor direct connected to a 65-volt generator with a blower rotor overhung on an extended shaft from the motor end of the set. The generators of the two sets furnish power for the operation of control, lights, compressor, and exhausters, with one of the sets serving as an exciter for

(*Continued on page 381*)



Traction-motor wheel-and-axle unit

Developments in

Train Communication

The value of end-to-end and train-to-wayside contact is being established by continuing tests and new installations

The engineman in the cab of a Rock Island Diesel-electric locomotive talks with the yardmaster

A SUMMARY of what the railroads have been doing with train communication systems was published in the June issue of *Railway Mechanical Engineer*. Since that time, there have been a number of new developments, which are summarized in the following paragraphs:

Rock Island Tries 40 Mg. Radio in Yard Service

Radio telephone communication in yard service was formally inaugurated by the Chicago, Rock Island & Pacific at its Burr Oak yard at Blue Island, Ill., on June 5. The requisite federal permission was granted the Rock Island on May 30 by the Federal Communications Commission—which authorized the use of two-way radio communication between yard offices and train engines or cabooses; yard-to-yard; dispatcher to trains, engines or cabooses; brakeman or flagman to trains, engines or cabooses; and end-to-end of trains. Radio telephone and radio telegraph emission is authorized, including the use of both amplitude modulation and frequency modulation. Frequencies authorized are within the bands 30 to 40 megacycles and 100 to 400 megacycles.

The radio equipment so far used in these experiments has all been frequency modulation (for elimination of static and interference) in the 30 to 40 megacycle band of frequencies. This equipment has been designed and installed by the railroad company. Because of difficulty in securing parts, no equipment for operation in the 100- to 400-megacycle band has been placed in service as yet. The installation inaugurated at the Burr Oak freight yard on June 5 consists of transmitting and receiving units used for communication between two yardmasters' offices and switching engines. Over 3,000 cars are handled in these yards daily, and the use of direct communications between the yard office and engineers is expected to facilitate the efficient make-up and dispatching of freight trains.

To date, two Diesel switchers have been equipped with F-M transmitting and receiving units in the 30-40 megacycle band of frequencies. These units have both loudspeakers and telephone sets, with the loudspeaker a telephone installed immediately in front of the engine in the cabs of the locomotives. The transmitting a receiving units are mounted on the floor below the windo behind the engineer's seat. The master control statio through which messages are relayed to and from the yar master and engineers, is located in the middle of t yard at the base of a 90-ft. light tower, upon wh the antenna is mounted. A loudspeaker and telepho are located in both the outgoing and incoming ya masters' offices. These are connected to the mas control station by conventional telephone circuits. T communication system has a range of 30 miles.

The transmitting stations, located in the two ya masters' offices, enable the yardmasters to speak to a engineer on his locomotive, within a radius of 50 mil and direct him in the switching of cars, making up, dispatching trains. When the yardmaster takes the e phone off the hook and presses the button, he may beg transmitting, and his voice will be carried by wire to t control station located in the middle of the yard. T message will then go out over the air by radio to t locomotive cab, where it will be received through a lou speaker. Each of these transmitting instruments equipped with an automatic volume control which kee volume and voice at proper level. The yardmaster m receive the engineer's message either through the e phone or on the loudspeaker which is part of the tra mitting-receiving set.

In the master control case on three shelves are tra mitting and receiving relay units; a remote control un consisting of a relay for simplex operation and an equa izer to control the volume of tone through the telepho line leading to the yardmaster's office; and a monit amplifier for checking the complete installation of t entire system. Through a loudspeaker in the master co trol case a monitor can hear both the engineer and t operator in the yard office. The receiver is crystal-co trolled single channel, tuned only to the frequency of t locomotives (39.540 megacycles).

When the yardmaster pushes the button which tur the transmitter on, a lamp is lighted in the locomoti cab, indicating that the station is on the air. While t dispatcher talks, a green light shows, and when his butt is released, a red light indicates that the engineer m begin to transmit his message back.

Under normal conditions, the power for these units provided by means of a motor-generator located und the hood of the Diesel locomotive, and is driven off t starting battery of the Diesel. Therefore, primary pow for the generator is always available. Due to war restri tions and slow delivery, these units are not available, a gasoline-generator sets were used temporarily. The transmitting receiving units use 300 watts when tra

mitting and 125 watts in stand-by or receiving service. The output into the air is 10 watts.

In continuing the research on the use of radio microwave communication in railroad work, the Rock Island plans to develop a radio system which will be installed for use between the rear and front ends of freight trains and which will be basically the same as the system operating now between the yardmasters and locomotives in the freight yard at Blue Island, except that an operating frequency of between 100 and 400 megacycles will be used. For long distance communication between dispatcher and engine or caboose, it is planned to use an installation that works on the induction principle, which will radiate at a frequency of 80,000 cycles. The power in the caboose will be generated by a wheel-driven generator which will charge batteries as the primary power source.

This radio work on the Rock Island was done by E. A. Dahl, electronics engineer, under the general supervision of C. O. Ellis, superintendent of telephone and telegraph.

Santa Fe Tests Radio on 2,200-Mile Trip

At Bakersfield, Calif., on June 14, the Atchison, Topeka & Santa Fe dispatched a freight train equipped with a radio communication system for a test covering the 2,200-mile run to Chicago, Ill.

The purpose of the trip was to make preliminary tests of end-to-end of train radio communication on a freight train in actual road service; using ultra-high frequency (more than 100 megacycles) amplitude modulation radio equipment under a wide range of physical and atmospheric conditions, such as mountains, deserts, rock cuts, tunnels, overhead power lines, bridges, rain storms, and elevations varying from nearly sea level to 7,248 ft. above sea level. On this test, various types of motive power were used, including freight Diesel-electric and several types of steam locomotives. The consist of the train also varied somewhat, as some cars were set out and others were picked up. During the trip, the total length of the train varied from 40 to 91 cars. Concerning the test, F. G. Curley, vice-president of the Santa Fe, said, "this run is only experimental, and there are many details to be worked out, but the use of radio has many possibilities in increasing the efficiency of both train and yard operations and also in easing the work of trainmen."

The equipment used consisted of a small portable transmitter and receiver at each end of the train. On the Diesel locomotive the antenna, which was 17½-in. high, and the transmitter-receiver units were mounted on top of the locomotive, with co-axial cable connections to a remote control box on the left side of the cab. At the rear end, the transmitter-receiver units were mounted on a shelf in the dining room of the business car, with co-axial cable connections to a remote control unit in that car and to another in the caboose. The rear antenna was mounted on the roof of the business car. With the remote control units at the rear end, officers in the business car and the conductor and brakeman in the caboose could call and talk to the head end, and the head end could call and talk to anyone in either car on the rear end.

The remote control unit is a small box about 3-in. wide, 4½-in. high and 2-in. thick. Each remote control unit has a switch, a volume control, a small red indicator light, a plug socket at the top for a loudspeaker and a hook on the side for a standard telephone headset. A small loudspeaker was plugged into each remote control unit, so that the voice from the other end of the train could be heard all through the caboose or locomotive cab. This made it unnecessary to watch the red light on the remote control box to determine if someone at the other end of the train was making a call. The phone has a small spring switch on the side of the grip. To call either end of the train from the other end, the trainman simply placed the phone to his ear, pressed the switch and talked as though conducting a normal telephone conversation. To listen, the thumb switch is released. At the receiving end, the voice is heard both over the phone and loudspeaker, so that the entire crew knows what is going on.

The primary power for this equipment was obtained from a 24-volt storage battery at each end, which was charged from the 32-volt engine current and similar current on the business car. The transmitter output on the air is about 5 watts.

At every point that crews were changed the cabooses were also changed and the remote control unit, telephone set and a loudspeaker were placed in the new caboose.

The conductor in the caboose of a Santa Fe freight train talks with the engineman on the locomotive around a curve ahead—The antenna with its one horizontal and one vertical member may be seen, right center beyond the cupola roof

This transition required about five or ten minutes. The business car remained on the train during the entire trip. The locomotives were changed less frequently than the cabooses and this change, which took about 50 minutes, involved removing the entire equipment on the front end and re-installing it on the new locomotive. On the steam locomotives, the radio equipment and antenna were mounted on the back of the tender with the remote control unit in the cab fastened to the end of the throttle frame, a location convenient to the left hand of the engineer. The loudspeaker was mounted overhead at the back of the cab behind the engineer.

The tests were satisfactory and the ultra-high frequency reception was clear and unaffected by rock cuts, overhead power lines, nearby lightning or the electric motors on the Diesel-electric freight locomotives. In a tunnel 700-ft. long, satisfactory communication was maintained while the locomotive was in the tunnel and the rear end of the train outside, and again with the rear end of the train in the tunnel and the locomotive outside. At several yards, the engine was cut off to go to the roundhouse to be serviced, and communication was maintained with the caboose for distances up to two miles.

During the trip, there were many instances where the radio served a useful purpose and promoted operating efficiency. For example, when a hot box was reported the conductor notified the engineer, who applied the brakes, stopping the train from the head end, instead of the conductor's having to use the emergency air-release valve at the rear. This procedure permits better control of slack and better handling of cars, less damage and less possibility of pulled-out drawbars.

When heading into a siding for a passenger train, the engineer would call the conductor and ask him to let him know when the rear end was clear, permitting a stop at that point and consequent saving of the brakeman's time in getting back to the train when the switch was closed.

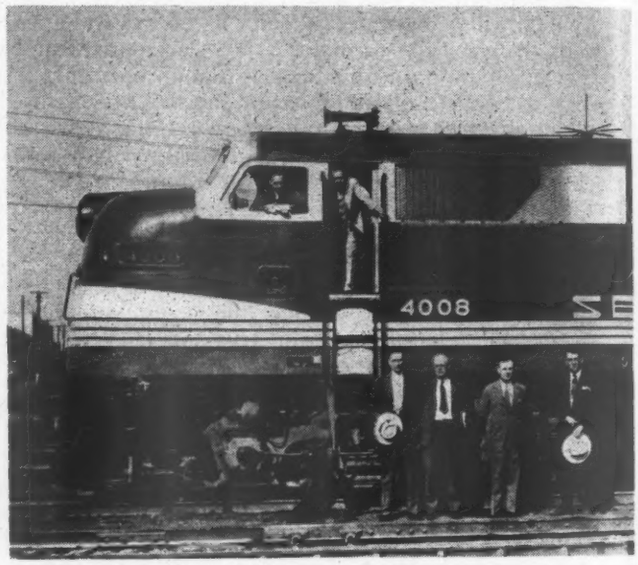
And, out on the main line, whenever the train stopped or slowed down, the conductor would immediately inquire what was wrong, and the reply "red board" or "yellow board," kept him fully advised. After a stop, when the rear brakeman was called back to the train from flagging, the conductor would give the engineer a verbal "high ball" when the brakeman was about 15 ft. from the caboose, and by the time slack was taken up, the brakeman would be back on board. This latter feature was a time-saver in itself, because, frequently, the front of the train is out of sight from the rear end and one of the crew would have to travel a third of the length of the train before hand signals could be seen.

In addition to the preliminary tests of train operation with the radio, the new equipment enabled operating officers to make air brake tests during the trip to learn how the brakes were taking hold and how long it took an application to reach the end of the train after being made at the head end.

The same equipment used on this test trip has also been used for communication between yardmasters and switching crews at Los Angeles, Calif., in a yard about 10 miles long. In this yard test one of the antennae was mounted on a pole 55 ft. high at one end of the yard. Satisfactory communication with switching locomotives was maintained throughout the yard for distances of as much as eight miles.

During the entire 2,200-mile test trip T. P. Brewster, superintendent of communications for the Santa Fe system, headed a party of specialists in communications aboard the train. With him were R. B. Moon, west coast manager of the Bendix Radio Division, Bendix Aviation Corporation, manufacturers of the equipment; L. R. Thomas, electronics engineer for the Santa Fe, and two Bendix installation engineers, C. D. Carter and H. A. Varley. At various points along the line, railroad officers joined the train to observe the tests.

Concerning the tests, Mr. Moon said, "It has been a generally accepted belief that communication employing ultra-high frequency transmission and reception such as provided by this equipment was possible only between points within line of sight of each other and unobstructed by any larger objects. However, it has developed during the tests conducted on this trip that direct line of sight is not necessary for communication over relatively short distances, since the antennae on the engine and caboose were obstructed in some manner at least 50 per cent of the time by deep cuts, curves around mountains, large metallic structures, etc."



Left to right are J. R. DePriest, superintendent of telegraph and signals, Seaboard Air Line; C. I. Morton, assistant superintendent; and M. H. Gold, assistant general manager. Bendix Radio officials are A. L. Bohn in cab window and W. H. Sims in door of locomotive.

Diesel-electric locomotive used for Seaboard radio communication tests—Antenna may be seen at right of roof on locomotive

The results of this test will be made available to the Telegraph and Telephone Section of the Association of American Railroads. This work was done by the Santa Fe under an experimental license by the Federal Communications Commission.

Seaboard Conducts End-to-End Radio Tests

A test run, employing radio communication between head-end and rear-end of a freight train, was conducted by the Seaboard Air Line from Richmond, Va., to Miami, Fla.

Announcing "pleasing results," J. R. DePriest, superintendent telegraph and signals, declared that "in conducting the present test between engine and caboose, the Seaboard is looking into the possibilities of providing radio communication over its entire system, not only for the dispatching of trains, but also for such other purposes as may be practicable and desirable."

A special type of radio receiving and transmitting unit, developed by the Radio Division of Bendix Aviation Corporation, was used. The equipment, composed of very high frequency, multi-channel radios, consisted of two similar installations, each containing a transmitter, receiver and power unit in a single compact case. One installation was mounted on the engine, the other in the

caboose. A handset, similar to the telephone, was supplied, and both engine and caboose had loudspeakers.

Mr. DePriest suggested benefits which might be expected through the use of radio, among them a saving of time and resultant shortening of over-all train schedules. This would result from such instances as a flagman being called back to his train after the train has completed a stop and is ready to proceed. The flagman, through the use of radio, could immediately report to the engineer when he was aboard, rather than relying upon hand signals, as at present.

In addition, he pointed out, when conditions necessitate the stopping of a train because of some mechanical difficulties, the conductor could quickly have the engineer make the stop in a normal manner, rather than apply the brakes from the caboose, with the possibility of damaging equipment.

"Many other uses of radio come to mind," Mr. DePriest concluded. "For instance, in getting trains into sidings, spotting cars, making up trains in yards, yard control of switch engines, etc."

Burlington Explores Usefulness of Radio Telephone

On June 22, the Chicago, Burlington & Quincy conducted a demonstration test of radio equipment for communication between a yard office, at 14th Street in Chicago, and a car attached to trains on a round trip between the Union Station in Chicago and Downers Grove, Ill., a distance of 20 miles. Executive, operating and communication officers of several railroads, as well as representatives of the Interstate Commerce Commission, the Federal Communications Commission and the press were guests on this trip.

Officers of the Burlington stated that the experiments being conducted on this railroad with the co-operation of the Bendix Corporation are for the purpose of exploring and developing the practicability and need for radio communication for railroad operating services. It is the thought that radio communication can be used to supplement rather than supersede the existing and well proven telegraph and automatic signaling facilities.

Negotiations for the Burlington-Bendix experiments were begun on December 29, 1943, and concluded on February 3, 1944. These experiments are being conducted in the frequencies above 150 megacycles where channels are said to be less crowded and, therefore, more readily available for permanent assignment. In order to conduct experiments in these high frequencies, it was necessary to obtain release from the army of certain equipment embodying war-developed inventions and improvements, as well as a permit from the Federal Communications Commission. This permit was issued May 3, and the installation was completed June 13.

The first series of tests is to determine the practicability and usefulness of two-way telephone conversation by radio between the assistant superintendent's office and the locomotive as well as cabooses in yard services in the Chicago area which extends west from Chicago to Congress Park, about 13 miles. The Burlington has as many as 75 switching crews employed in these yards. Further experiments will include tests of radio communication between the locomotives and the cabooses of moving freight trains on the roads, as well as between yard offices and switching crews at various locations on the Burlington.

Milwaukee to Test Inductive Communication System

The Chicago, Milwaukee, St. Paul & Pacific, starting in August, will make tests of the inductive system of train communication developed and manufactured by the Union Switch & Signal Company, and which has been in regular service on the Bessemer & Lake Erie and the Pennsylvania.

Unlike radio, the inductive system does not require wave length assignment. A carrier current, transmitted through the rails, the ground and the wires on the pole line along the right-of-way, is received by induction. Two-way telephone conversation is thus provided between enginemen and conductors as well as with crews of other trains or with operators in wayside stations.

According to information from the Milwaukee, the inductive system is expected to function successfully on the electrified territories of this road where high-voltage power lines parallel the tracks, and where there are many tunnels, both of which are said to be obstacles to dependable radio operation.

Sorocabana of Brazil

(*Continued from page 377*)

traction-motor fields during regeneration. The blowers furnish ventilating air for all force-ventilated electrical apparatus. The exhauster control is so arranged that normally only one is in operation and at a reduced speed, while both operate intermittently at full speed to assist in quickly creating the necessary vacuum to effect the release of train brakes.

Control Equipment

The high-voltage control equipment is located in the apparatus compartment in the center of the locomotive and includes the accelerating resistors, braking resistors, main circuit contactors, series-paralleling switch, reverser, JR circuit breaker, and other protective apparatus, switches and fuses. The low-voltage equipment is located in the two operating cabs and includes the master controllers, voltage regulator, pantograph magnet valves, control-circuit switches, and fuses and instruments.

Cast-iron grids are used for the high-current sections of the accelerating resistors while those in the lower-current sections and in the braking circuits are formed of edgewound strips of resistance alloy. All are insulated from their supporting frameworks which are in turn mounted on porcelain insulators thus affording double insulation to ground throughout.

The high speed JR circuit breaker protects the main circuits from short circuits and also from overload through the medium of overload relays in the traction-motor circuits; it also protects the equipment against overvoltage during regeneration through the medium of an overvoltage relay.

Manually-operated starting switches are used for the operation of the two motor-generator sets and a selector switch for alternative selection of the continuously operated exhauster. An automatic relay transfers the auxiliaries normally operating on the exciter motor-generator set to the auxiliary motor-generator set during regeneration. The main circuit contactors, series-paralleling switch, reverser, and braking switch are electro-pneumatically operated by low-voltage control circuits energized in proper sequence from the master controller.

Each master controller is equipped with a main handle controlling accelerating and full-field running steps in motoring, a selector handle for selecting motor combinations for regenerative braking, a braking handle governing regeneration and also governing shunt-field steps in

motoring, and a reverser handle for selecting direction of motion of the locomotive. All handles are mechanically interlocked to prevent improper operation and are conveniently located and in easy reach of the operator. The instrument panel is mounted beneath the front window directly in front of the engineman and contains a line voltmeter, traction-motor field ammeter, traction-motor line ammeter, locomotive speed indicator, vacuum-brake gauge, and an air-brake gauge, all of which are indirectly illuminated from the rear of the panel.

The air- and vacuum-brake valves are on the right of the operating position, the master controller on the left. Bell-ringer and sander valves, control push buttons and valve for the pneuphonic horn are all mounted so as to require a minimum of movement on the part of the engineman. A record of power consumed during motoring and of power returned to the line when regenerating is obtained by means of a duplex watt-hour meter.

Though the motor on the left is but half as large as the one on the right, both produce 10 hp. at 1,750 r.p.m.—Higher operating temperature makes this possible—The left-hand motor is made with high temperature Silicone insulation and operates at 175 deg. C. total hot-spot temperature, while the right-hand motor is made with Class A insulation and operates at 105 deg. C.—The left-hand motor weighs 210 lb. and the right-hand motor 410 lb.

Silicone Insulation Increases Motor Ratings

*By R. C. Bergvall**

As much as 50 per cent reduction in weight of electric equipment is possible where design limitations are based on insulating temperature by using the new Silicone insulating varnishes. These high temperature insulations also make possible a substantial increase in the output of small motors using the same frame, where the operating temperature can be raised. They offer the additional advantages of ability to operate at higher ambient temperature, and to greatly increase life when operated at present temperature conditions. Silicone resins, and their use as insulating varnishes and bonds, definitely fill the void between organic and inorganic insulating materials.

There has long been a demand for high temperature insulation having better thermal stability. Designers have felt the need for such insulation for the three following reasons: It offers possibilities for reduction in the size and weight of electrical equipment, with no reduction in service life, where the operating temperature can be increased because of this improved thermal endurance. It may be used to obtain greatly increased service life in the same size and weight where it is necessary or desirable to maintain present temperature limits. It should allow increased ambient temperatures which reduce limitations as to operating locations.

Recently developed Silicone resins and varnishes have tremendously better thermal endurance than any of the known resins and varnishes. New high temperature insulations have been developed utilizing these materials. As a result, it is possible to produce electrical equipment that has a much greater thermal endurance; as high as twenty to one on laboratory tests.

The Silicone materials bridge the gap between conventional organic insulating materials, which are limited with respect to heat stability, and ceramic type materials, which are not limited with respect to heat stability. Physically, they are quite similar to conventional resins, varnishes, and organic structures, but differ in that they do not readily decompose at temperatures of the order of 200 deg. C. In actual use, the conventional insulating structures have been modified to incorporate Silicone resins throughout. This results in an integrated line of insulating materials which will withstand abnormally severe operating temperatures.

Over two years' experience on actual equipment confirms extensive laboratory tests which showed these materials to be promising. For example: To meet a very special requirement, a 3-hp., totally-enclosed induction motor was redesigned for 10 hp. with no increase in weight or size. Since then, more than 30 similar motors using high temperature insulation have been built and are now being tested under various conditions. A mine locomotive motor armature has been functioning perfectly under very adverse conditions for over a year since being rewound and high temperature insulated. Prior to this insulation failures occurred frequently, a few less than a month apart. Street car and trolley coach motors with Silicone insulation have been given exhaustive tests at elevated temperatures. Results show increased horsepower output at no increase in speed with no injury to insulation.

A 250-kva. generator with high temperature insulation was operated in the laboratory for about 3,000 hours at 250 deg. C. with no ill effects to the insulation. According to the best available means for interpreting accelerated life tests, this should be equivalent to far more than normal life expectancy.

High temperature insulation on several hundred operating coils for magnetic contactors overcame a serious burn-out problem resulting from excessive temperatures within the control box. Operating for more than a year without a single failure is the record for Silicone insulation as contrasted to coils failing within a year for conventional insulation. Air-cooled transformer life has been increased and output improved when insulated with high temperature materials. Several hundred are now in service.

Where temperature, or size and weight as determined by temperature, are important factors in electrical equipment, the problem should be examined in the light of these recently developed insulating materials. Silicone insulations should not be considered a panacea for all insulating ills, but instead, should be applied to specific applications where its use is justified.

* Assistant to vice-president, Insulation Development Group, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

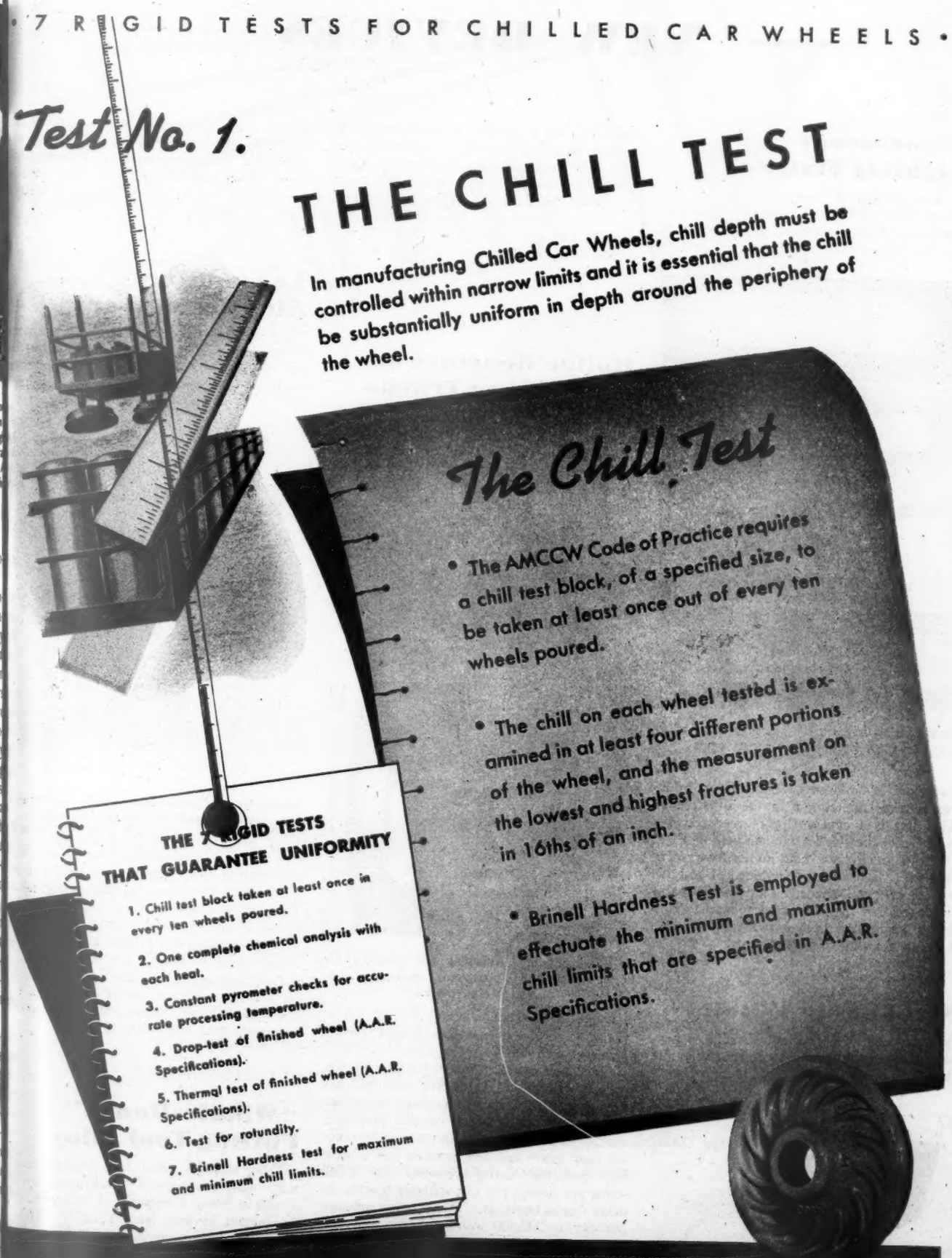
(Turn to next left-hand page)

• 7 RIGID TESTS FOR CHILLED CAR WHEELS •

Test No. 1.

THE CHILL TEST

In manufacturing Chilled Car Wheels, chill depth must be controlled within narrow limits and it is essential that the chill be substantially uniform in depth around the periphery of the wheel.

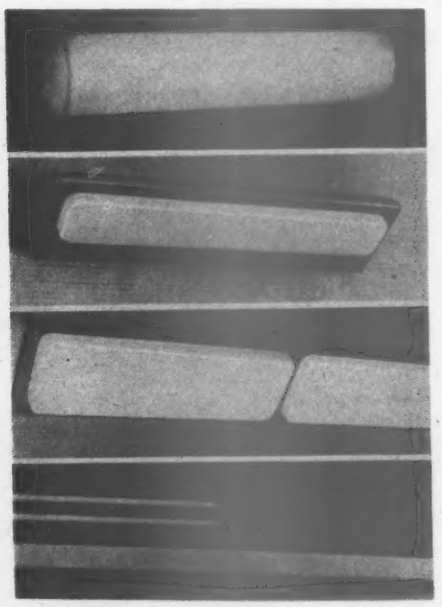

The Chill Test
• The AMCCW Code of Practice requires a chill test block, of a specified size, to be taken at least once out of every ten wheels poured.
• The chill on each wheel tested is examined in at least four different portions of the wheel, and the measurement on the lowest and highest fractures is taken in 16ths of an inch.
• Brinell Hardness Test is employed to effectuate the minimum and maximum chill limits that are specified in A.A.R. Specifications.
THE 7 RIGID TESTS THAT GUARANTEE UNIFORMITY
1. Chill test block taken at least once in every ten wheels poured.
2. One complete chemical analysis with each heat.
3. Constant pyrometer checks for accurate processing temperature.
4. Drop-test of finished wheel (A.A.R. Specifications).
5. Thermal test of finished wheel (A.A.R. Specifications).
6. Test for rotundity.
7. Brinell Hardness test for maximum and minimum chill limits.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

NEW DEVICES

Fluorescent Lighting Fixtures

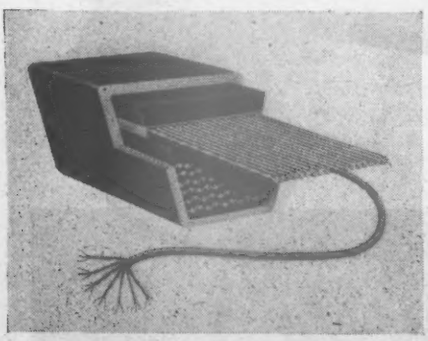
A wide variety of fluorescent lighting fixtures with white translucent Plexiglas shades is in the processes of development by the Safety Car Heating & Lighting Company, New Haven, Conn. Four different fixtures are shown in the illustration. The first is a capsule light; the second a wall light; the third a tandem ceiling light, and the fourth is a continuous fluorescent side-wall light with combined Plexiglas and sheet-metal shade. The plastic material used can be fabricated to satisfy any design requirements and its strength introduces a desirable safety factor.



Four lighting fixtures for passenger cars made of Plexiglas for fluorescent lamps

Steel Cable V-Belt

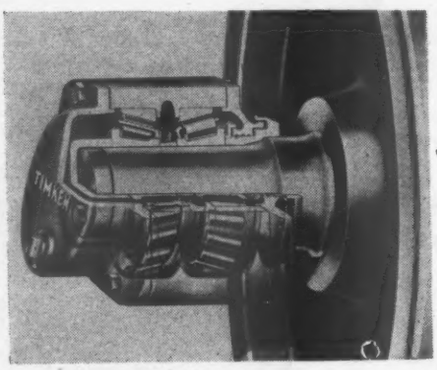
A steel cable V-belt which is said to possess great strength and to be more flexible than cotton or rayon cord is now being employed on a number of railroads. The stretch factor of the belt is practically zero and it is small enough in diameter to fit readily in standard V-belt drives. The roads on which this belting is being used employ it on air compressors, fans, blowers, generators and air-conditioning units. It is a product of the Goodyear Tire & Rubber Company, Akron, Ohio.



Steel cable woven in this belting adds strength and reduces the stretch factor

Roller Bearings on Freight-Car Trucks

The Timken Roller Bearing Company, Canton, Ohio, has developed a new type of roller-bearing application for all types of high-speed freight-car trucks, both of the inboard and outboard type. These new high-speed freight-car applications have all of the inherent advantages of the roller-bearing applications which have performed successfully for many rears under high-speed streamlined trains and all types of locomotives. This company has been testing and operating many designs of roller-bearings for freight-cars for a number of years and the only freight cars in high-speed mainline service equipped with anti-friction bearings are Timken equipped.



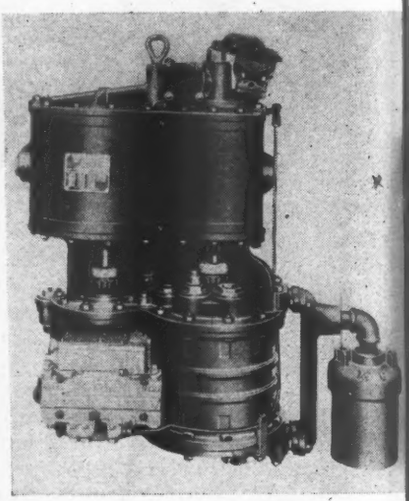
Timken bearing assemblies are available for both inboard and outboard applications on freight-car trucks

One such installation comprising 10 box cars is on the Union Pacific and the cars are used in high-speed merchandise service and at the head end of certain passenger trains. These box cars have been in service four years and ten months, and during this time they have averaged over 4,000 miles per month per car without trouble or delay due to bearings. The average mileage per car is 230,300 miles to date and the highest total mileage credited to any single car is 265,649 miles.

The inboard freight truck with the bearings between the wheels was tested in service under one hundred 70-ton hopper cars with the test results indicating that starting resistance was only slightly greater than low speed rolling resistance. In addition, it was found that resistance was practicall the same at all temperatures. Further ap plications have been made to several hun dred 70-ton and 90-ton dump cars used i ore service and on various types of freigh cars for military service.

Locomotive Air Compressor

The Westinghouse Air Brake Company Wilmerding, Pa., is now in production o an 8½-in. locomotive air compresso equipped with an integral A type governo



Locomotive air compressor which has integra governor and mechanical lubricator

and an F-2 mechanical lubricator. Th governor is located on the top head and th mechanical lubricator on the air cylinders Integral mounting of these auxiliaries sim plifies installation and maintenance as con siderable piping and fittings associated wit independent mounting are eliminated.

Only one short oil tube is required, in jecting mist lubrication to the steam en for the governor, steam valve, compresso reversing gear and steam cylinders.

"Middle-Range" Cutting Tool Alloy

A cast cutting alloy for "middle-range machining applications is marketed by th Crucible Steel Company of America, 40 Lexington Avenue, New York 17. This i a non-ferrous cutting alloy, called Rexalloy intended for increasing production and low ering machining costs in the intermediat field between work which can be service by high-speed steel cutting tools and wor requiring the use of tungsten carbide tool The composition is approximately 33 pe

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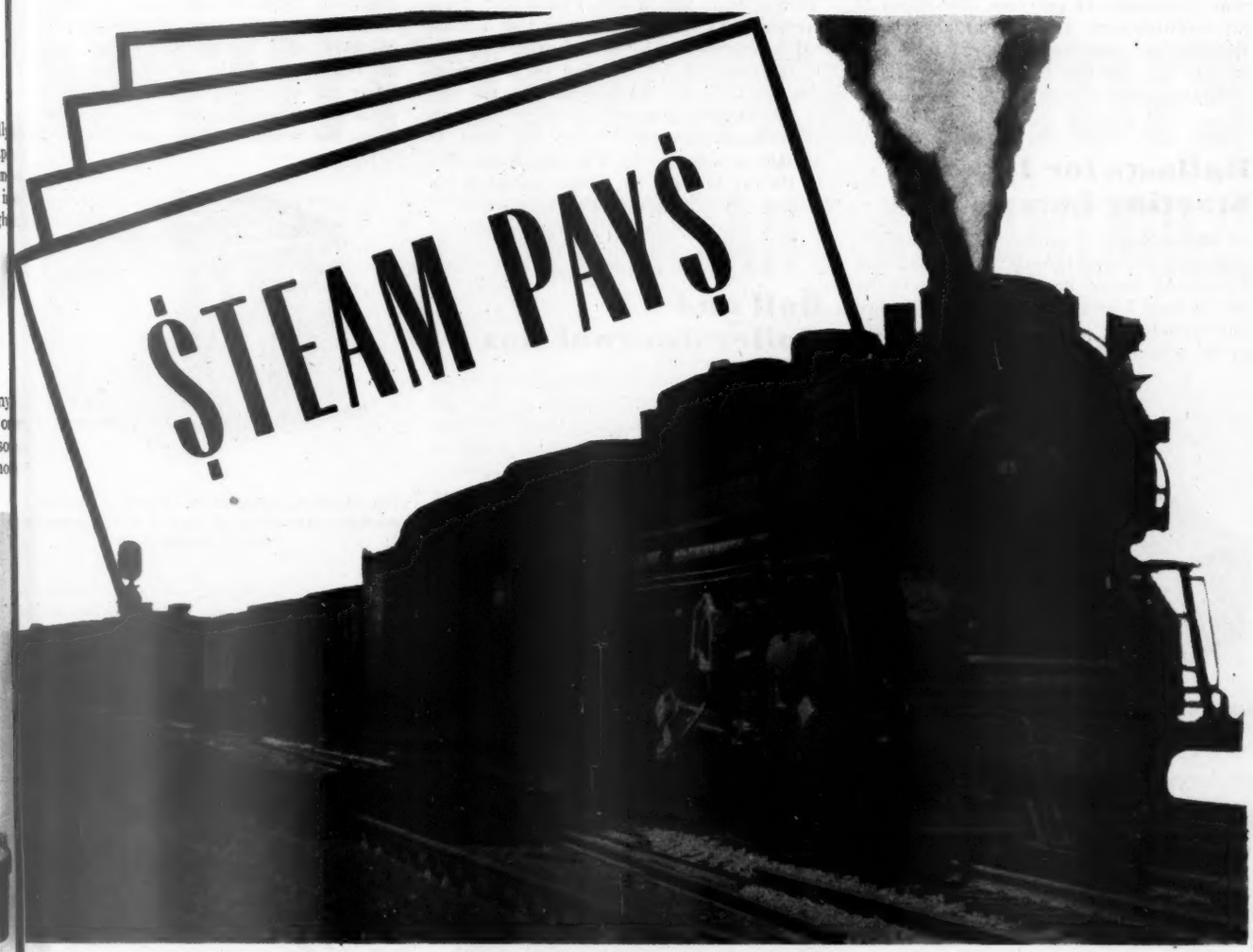


greater returns per dollar of investment

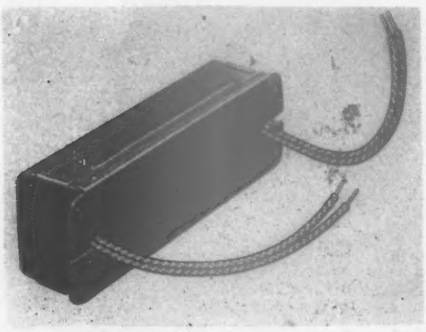
The low initial cost and low maintenance cost of high-speed, super-power steam locomotives, as compared with that of other types of prime movers, makes them the highest money earners per dollar of investment. Not only do steam locomotives have all the speed you can use, but they also have the capacity of interchangeability on fast and heavy freights as well as on crack passenger runs. For greater returns on your investment dollar specify Lima-built, super-power steam locomotives.

LIMA LOCOMOTIVE WORKS — LIMA LOCOMOTIVE WORKS INCORPORATED — INCORPORATED, LIMA, OHIO

cent chromium, 44 per cent cobalt and 17 per cent tungsten. It is said to have exceptionally high red-hardness characteristics and to be superior in toughness, shock resistance and resistance to abrasive wear.

Ballasts for Instant-Starting Lamps

A high-voltage, Tulamp ballast, for the operation of new 40-watt, instant-starting fluorescent lamps, has been announced by the General Electric Company. It applies 450 volts to the lamp at starting, striking an arc between the lamp cathodes, and thus



Ballast designed to operate two instant-starting, 40-watt fluorescent lamps

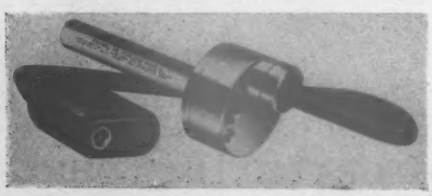
eliminating the need for separate starter equipment. The ballast is now available in Tulamp 40-watt ratings for use on 118-volt circuits.

The ballast delivers rated watts to the lamp at nominal circuit voltage. Uniform light output is closely maintained even when the circuit voltage varies within the recommended operating range. Power losses are greater than in the conventional preheat ballast circuit.

The ballast provides high power factor and corrects cyclic light flicker. Special filters for suppression of radio interference are incorporated. The ballast is housed in a universal case that allows the leads to be brought out at either the end or the bottom, permitting flexibility of installation and complete utilization of present fixture designs.

Hot Journal Alarm

A thermoswitch, consisting of a basic element with a forged, bronze head and heavy-duty cable connector is being furnished by Fenwal, Inc., Ashland, Mass., for the detection of overheating in journal boxes as a means of preventing delays and accidents. Basic features of the switch are small-size enclosed contacts, high sensitivity and freedom from the effects of vibration. They are used to signal the engineer that a journal is overheating before a hot box occurs. If the controls are installed on a locomotive, the circuit is made directly to the cab. If the controls are applied to the journals of a passenger coach, they are used to actuate a solenoid in the signal air line on the car to relay the danger signal to the engineer in the cab of the locomotive.

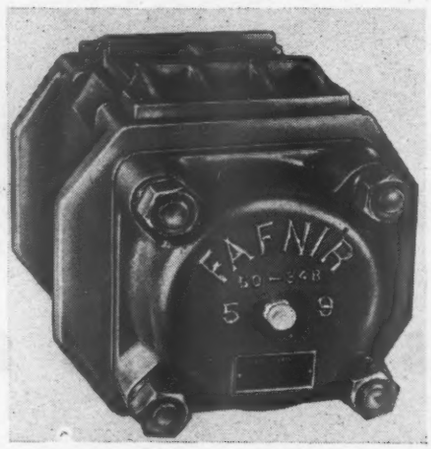


A device which can be installed in journal boxes to give warning of overheating before a hot-box occurs

Ball and Roller Journal Box

Two improvements in its ball and roller journal box recently announced by the Fafnir Bearing Company, New Britain, Conn., are a design change which makes it possible to reverse the housing both horizontally and vertically and doubles the wear life of the box, and a convenient cap which can be easily removed, making it possible to check lateral clearance without removing the entire cover.

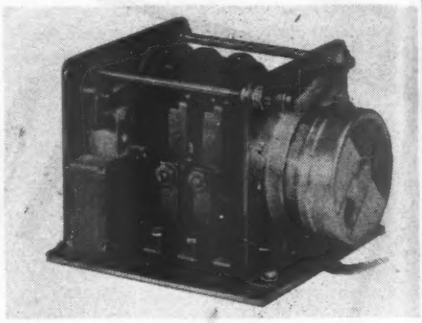
The newly designed box has the same lateral clearance as other types of Fafnir journal boxes to improve riding qualities and reduce shock impact. Positive lubrication is maintained at all speeds. Dirt and water are sealed out. The assembly is adaptable to Standard A.A.R. pedestal openings. Inner rings need not be removed at wheel turning periods.



The housing of this journal box can be reversed completely to add to service life

Multi-Contact Timer

A multi-contact timer for remote control has been placed on the market by The R. W. Cramer Company, Inc., Centerbrook, Conn. It is used to control a series of machine operations in definite order: to automatically reverse or alternate in operation a group of motors, machines or devices; to operate in a predetermined sequence a series of signals, valves or solenoids, as well as other applications where sequence operations are of prime importance. Its solenoid starting mechanism is operated from a remote-control momentary-start button, so that the timer will go through its complete cycle or any part of its cycle of operation and stop. Reclosing the momentary start button will either continue or repeat the cycle as the case may be. They can be arranged so that in the event of a power interruption it is necessary to press the remote control start button again

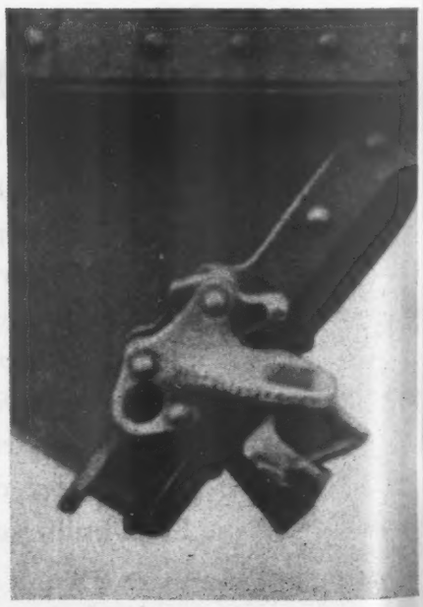


The timer is designed to control a number of machine operations or signals in a predetermined sequence

to continue the cycle, or, after power is restored to continue operation automatically.

Hopper-Door Lock

Hopper-door locks manufactured by the Wine Railway Appliance Company, Toledo, Ohio, have been redesigned to incorporate a feature which facilitates the adjustment of door fit and compensates for irregularities in car construction. The spreader extension for the doors now has an eccentric on the inner end as a means of adjusting, quickly and accurately, the clearance between the door and the hopper frame. When it is



Hopper door lock redesigned to insure tight fitting doors on sawtooth-type hopper cars

applied, proper adjustment is obtained by rotating the eccentric before driving the holding rivet. This adjustability is said to add further to the effectiveness of these locks in preventing leakage of lading.

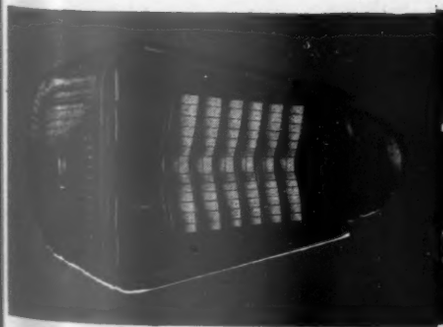
(Turn to next left-hand page)

Security Circulators

ASSURE THESE IMPORTANT ADVANTAGES

1. POSITIVE FLOW OF WATER OVER CENTER OF CROWN SHEET
2. REDUCED HONEYCOMBING
3. REDUCED FLUE PLUGGING
4. REDUCED CINDER CUTTING
5. BETTER ARCH BRICK SUPPORT

ALL OF WHICH RESULTS IN GREATLY INCREASED *LOCOMOTIVE AVAILABILITY*



AMERICAN ARCH COMPANY, INC.

SECURITY CIRCULATOR DIVISION

NEW YORK CHICAGO

NEWS

Freight Car Backlog Will Be Exhausted Early in 1945

THE total backlog of freight cars undelivered June 30, 1944, comprised 46,921 cars, of which all but 119 have been authorized for delivery by the War Production Board. Included are 45,026 cars (100 unauthorized) remaining to be shipped to 61 railroads and 1,895 cars (19 unauthorized) on order for private car lines and industrial companies. The 46,802 authorized consist of 30,826 scheduled for building in contract car builder plants and 15,976 in railroad shops. Included in the total backlog are 19,903 box, 14,527 hopper, 8,265 gondola, 2,504 refrigerator, 421 flat, 500 stock, 405 tank, 87 dump and 301 caboose cars.

Delivery schedules on the 46,802 cars authorized call for the building of an average of 6,000 cars monthly during the last half of this year, or a total of 25,444 by contract builders and 10,788 by railroad shops. The balance of 5,382 cars on order with contract builders are scheduled to be turned out early in 1945. Most of the cars presently on order in railroad shops will also be completed during the first quarter, 1945, although in some instances these contracts run through the first six months of next year with a greatly reduced output during the second quarter.

Head-End Lighting for C. N. J. Equipment

THE Central of New Jersey has obtained approval of the War Production Board to equip 20 locomotives and 100 coaches with head-end lighting. Under the new system a steam-operated turbo generator will be installed on the locomotive tender to supply illumination for the entire train. Installations will begin as soon as the materials arrive. The railroad plans to equip 40 more locomotives and 200 cars in the same way in subsequent years so that all commuter coaches will have the new lighting.

The present system using an individual battery on each car, charged by an axle-driven generator, prevents battery-charging difficulties on short runs with frequent stops.

Two Eastern Roads Plan Complete Dieselization

New York, Ontario & Western.—On June 28, Frederic E. Lyford, trustee of the Ontario & Western, petitioned the federal district court at New York for authority to effect complete Dieselization of the motive power of this road. Trustees of both mortgages, and representatives of bondholders, supported the petition, and it was granted by the court.

The cost of the project is estimated at $6,700,000. Orders for 37 Diesel-electric locomotives of various sizes have already been ordered as noted in the table of orders elsewhere on this page.

New York, Susquehanna & Western.—The Susquehanna has been authorized by the United States District Court of New Jersey to purchase eight Diesel-electric road locomotives of 1,000-hp., an order for which has been placed with the American Locomotive Company as noted in the table of orders elsewhere on this page. It is the intention of the Susquehanna to completely Dieselize its present passenger service and, with the return of its freight traffic to pre-war levels, to eliminate steam locomotives altogether.

D. & R. G. W. Oil and Waste Reclamation Plant

THE Denver & Rio Grande Western has obtained preference ratings from the War Production Board for materials for the construction of a plant at Pueblo, Colo., for reclaiming journal box oil and waste. The estimated cost is $61,604.

Charles A. Powel Becomes A. I. E. E. President

CHARLES A. POWEL, manager of Headquarters Engineering of the Westinghouse Electric & Manufacturing Company, was elected president of the American Institute of Electrical Engineers for the year beginning August, 1944.

The President's badge was presented to Mr. Powel at ceremonies opening the Institute's Summer Technical Meeting, June 26 to 30. A former vice-president and director of the A. I. E. E., and long noted as a diagnostician of power-plant problems, Mr. Powel succeeds Dr. Nevin E. Funk, vice-president of the Philadelphia Electric Company.

Orders for Equipment Light During First Six Months

ORDERS placed for new railroad equipment during the first six months, 1944, totaled 23,072 freight cars, 62 steam locomotives and 334 passenger-train cars. Of the 23,072 freight cars, 21,822 were ordered by 24 railroads including 13,502 box, 7,72[illegible] hopper, 500 gondola and 100 stock cars; 15[illegible] flat cars were ordered by two industrial companies; 100 refrigerator cars by the American Refrigerator Transit Company and 1,000 refrigerator cars by the Pacific Fruit Express. Railroad orders were divided 18,097 to contract car-builders and 3,725 to company shops. Among the larger car orders placed were 1,100 50-ton box, 10[illegible] 50-ton hopper and ten 70-ton hopper cars by the Central of Georgia; 5,000 50-ton hopper-coal cars by the Chesapeake & Ohio; 2,000 50-ton box cars by the Chicago & North Western; 4,000 55-ton box and 1,00[illegible] 55-ton hopper cars by the New York Central; 2,000 50-ton box cars by the New York, New Haven & Hartford; 1,000 50-ton box cars by the Southern; and 50[illegible]

Orders and Inquiries for New Equipment Placed Since the Closing of the July Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Akron, Canton & Youngstown	1	2-8-2	Lima Loco. Works
Boston & Maine	6[1]	5,400-hp. Diesel-electric	Electro-Motive
New York, Ontario & Western	21[2]	5,400-hp. Diesel-electric	Electro-Motive
	16	1,000-hp. Diesel-electric	Electro-Motive
New York, Susquehanna & Western	8[3]	1,000-hp. Diesel-electric	American Loco. Co.
Pennsylvania	25[4]	4-6-4-4	Co. shops
Union Pacific	5[5]	4-8-8-4	American Loco. Co.
	20[5]	4-6-6-4	American Loco. Co.
	10[5]	4-8-4	American Loco. Co.

LOCOMOTIVE INQUIRIES

Virginian	8	2-6-6-6

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Missouri Pacific	25[6]	70-ton hopper	American Car & Fdry.

FREIGHT-CAR INQUIRIES

Alton	1,000	50-ton box
	250	50-ton hopper
	250	50-ton gondola

[1] The B. & M. previously had ordered twelve locomotives of the same type from Electro-Motive, six in March 1942, and six in March, 1943. Of the total of 18 ordered, four are now in service with eight scheduled for delivery this year and six in 1945.

[2] See "Two Eastern Roads Plan Complete Dieselization" elsewhere on this page.

[3] Purchase approved by U. S. District Court of New Jersey. See "Two Eastern Roads Plan Complete Dieselization" elsewhere on this page.

[4] This order follows one for a locomotive of the same type previously ordered in January. The railroad had previously ordered seven steam locomotives of 2-10-4 wheel arrangement from its own shops in March.

[5] All coal-burning locomotives—25 for freight service; 10 for passenger service. Purchase price $10,000,000. Delivery expected to be completed in December.

[6] Aluminum alloy will be used for the entire bodies of these cars, while the center sill and bolsters will be steel. The cars will each have an empty weight of about 37,100 lb., compared with an average of 50,100 lb. for conventional all-steel 70-ton hopper cars. They will be 39-in. longer than the usual all-steel units, permitting a capacity increase of 240 cu. ft. The aluminum sheets are to be somewhat thicker than the conventional steel sheets, giving them equal strength.

-ton box and 500 50-ton gondola cars by e Wheeling & Lake Erie.

No provision for passenger-train car onstruction has yet been made by the ar Production Board and orders were aced subject to future release by that ency. In addition to the orders for 334 rs by three railroads (Louisville & Nashille, Missouri Pacific and New York Cenal), other carriers evidenced intention to rchase passenger equipment or entered the arket with inquiries during the sixonths' period. Among these is the inquiry the Pere Marquette for 14 cars for two reamline trains. Only domestic orders ported last year, which are still pending, ere six express and two baggage-mail rs by the Central of Georgia and 50 aches by the Boston & Maine.

The 66 steam locomotives ordered included 29 by five railroads from the three ntract builders and 33 by the Pennsylania from that road's own shops. At the d of June, there were a number of unled inquiries in the market including six 6-6 type locomotives for the Chesapeake Ohio; for four 2-8-4 or 2-8-2 type enines for the Tennessee Central; and for e 4-8-4 type engines for the Western aryland.

Diesel-electric locomotives are built for ock and blanket authorizations covering number of locomotives granted to buildrs. Directives respecting deliveries are sued by the War Production Board pedically. During the first five months 1944, 21 Diesel-electric locomotives of 0 hp. were delivered and, at June 1, ere were 54 scheduled ahead and asgned, 44 in 1944 and 10 in 1945. There ere 175 Diesels of 1,000 hp. delivered uring the period with 241 scheduled for e remaining months of this year, of hich 66 are assigned and 175 unassigned, nd 71 scheduled ahead for 1945, all asgned. Ten 2,000-hp. Diesel locomotives ere delivered with 15 scheduled ahead r 1944, 13 assigned and two unassigned, nd 15 scheduled for 1945, 12 assigned and hree unassigned. No 4,000-hp. Diesels ave been built or are scheduled for buildg this year, but there are 16 scheduled for 945, all unassigned. There were 43 5,400p. Diesel freight engines delivered, 83 cheduled for the succeeding seven months f this year and 23 for 1945, all of which re assigned.

Mechanical Division, A. A. R.

Report on Lubrication—A Correction

In abstracting the report of the A. A. R. Mechanical Division Committee on Lubrication of Cars and Locomotives under the paragraph headed "Interchange Rule 66" on page 332 of the July *Railway Mechanical Engineer,* the erroneous impression is given that the committee recommends a mixture of 50 per cent new and 50 per cent renovated waste for journal packing with Specifications M-904, M-905, M-906 and M-910. As a matter of fact this recommendation applies only when new waste is used and then the 50 per cent of renovated waste is a minimum requirement. The exact wording of the committee's recommendation, taken from Exhibit A, Item 1, Sec. (d) of the report is as follows: "When using new waste, it is preferable to thoroughly mix it with renovated waste prior to saturating, using at least 50 per cent renovated waste in the mix."

Failure of Hand-Brake Rods and Chain Links

According to a circular letter issued under date of June 30 by the A. A. R., Mechanical Division, there has been a considerable increase in car delays and damage to equipment, due to failure of hand brake rods and chain links. Investigation indicates that the principal causes of these failures are opening of the hook on end of hand brake rod and failure of brake chain links due to improper weld.

To overcome these failures, the letter recommends that the hook-end style of hand brake rod be discontinued and the jaw-type or solid-eye rod with clevis be substituted when rods are being replaced or when cars are receiving heavy or program repairs. The letter requests that special attention be given to the welding of hand brake chains to insure that proper welding methods are employed and that repaired links provide full strength.

Bryant Appointed Director of W. P. B. Equipment Division

C. B. Bryant, assistant to vice-president of the Southern, has succeeded G. M. Betterton, general purchasing agent of the Southern Pacific, as director of the War Production Board's Transportation Equipment Division. Mr. Bryant's appointment became effective July 1 when Mr. Betterton, who had been on leave of absence, returned to the S. P.

C. B. Bryant

Mr. Bryant was born November 1, 1900, at Washington, D. C., and is a graduate of Johns Hopkins University, School of Engineering and Chemistry (1902), where he received a B.S. degree. During the following eight years he was employed by the Portland Cement Association as a field engineer, and from 1930 to 1936, he was in the service of the Maryland State Roads Commission as a materials engineer.

On November 16, 1936, Mr. Bryant entered railroad service with the Southern as engineer of tests with headquarters at Alexandria, Va. On November 1, 1943, he was appointed assistant to vice-president. Among various other committee activities, Mr. Bryant is a member of the Subcommittee on Engineering and Mechanical Research of the Railroad Committee for the Study of Transportation, the postwar study group sponsored by the Association of American Railroads and operating under the chairmanship of A. A. R. Vice-President R. V. Fletcher.

Miscellaneous Publications

Proceedings, Car Department Officers' Association, 1943. Secretary-Treasurer F. H. Stremmel, A. A. R. Mechanical Division, 59 E. Van Buren St., Chicago. 106 pages, 5¼ in. by 8½ in. Bound in cloth. Price $2.00.

D. S. Ellis Manager Nominee of A. S. M. E.

Following the semi-annual meeting of the American Society of Mechanical Engineers, at the William Penn hotel, Pittsburgh, Pa., June 19 to 22, announcement was made of the nominations for the 1945 officers of A. S. M. E. Election is to be held by letter ballot of the entire membership, with September 26 set as the closing date.

Nominee for president is Alex D. Bailey, vice-president, Commonwealth Edison Co., Chicago. Nominations for vice-president are: David Larkin, vice-president and general manager, Broderick & Bascom Rope Co., St. Louis, Mo.; John E. Lovely, vice-president, Jones & Lamson Machine Co., Springfield, Vt., and Thomas S. McEwan, vice-president, McClure, Haddon & Ortman, Inc., St. Louis.

Nominated as managers are: Daniel S. Ellis, vice-president charge of manufacturing, Lima Locomotive Works, Inc., Lima, Ohio; Arthur J. Kerr, district manager of sales, Pittsburgh Equitable Meter Co., Tulsa, Okla.; and Herman George Thielscher, mechanical engineer, Potomac Electric Power Co., Washington, D. C.

I. C. C. Ceremony Memorializes Eastman

Testimonials to the high esteem in which Commissioner Joseph B. Eastman was held by practitioners before the Interstate Commerce Commission by his fellow members of that body, and by others associated with him in public life, were formally entered upon the permanent record of the commission's deliberations in a memorial ceremony in the commission's large hearing room at Washington, D. C., on July 11. At the conclusion of the session Secretary W. P. Bartel unveiled for the commission a portrait of Mr. Eastman, which is to be placed in the central foyer of the I. C. C. building, along with those of other commissioners whose services have terminated.

Railroad Industry Honored for Safety Record

Belying the propaganda of political origin which accuses the railroads of inattention to safety, the American Museum

(*Continued on second left-hand page*)

4½ Round Trips to the MOON

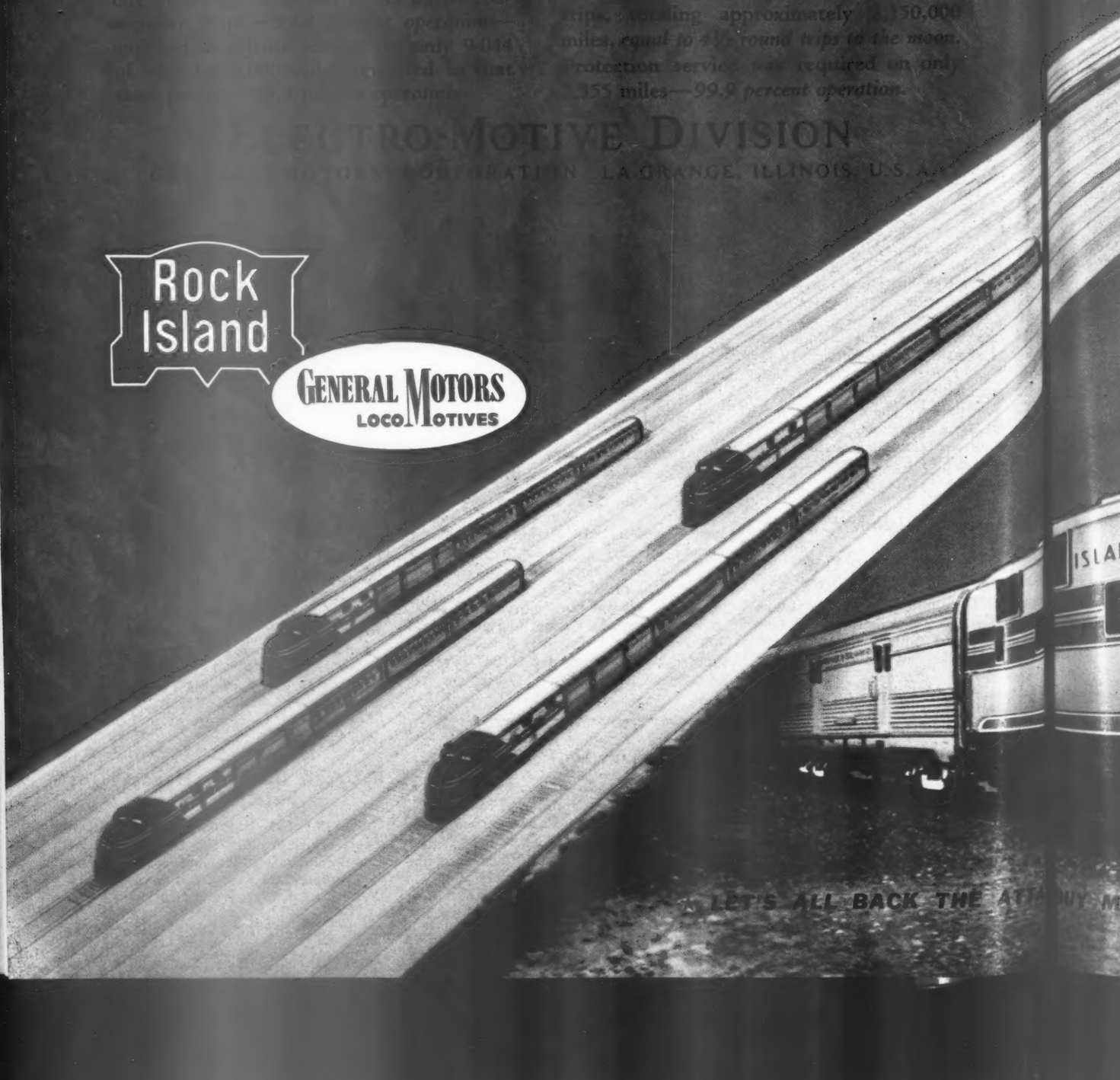
When the Chicago-Des Moines Rocket rounded out its six years of unbelievable performance, it had completed a total of 2,505,053 miles with substitute service on only five of its 4,390 trips—*99.8 percent operation.*

An even more remarkable record is that of the Rocket operating between Kansas City and Minneapolis, a distance of 489 miles. In six years of operation, this train missed every one of its 4,386 scheduled trips, traveling approximately 2,150,000 miles, *equal to 4½ round trips to the moon.* Protection service was required on only 355 miles—*99.9 percent operation.*

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION LA GRANGE, ILLINOIS, U.S.A.

Rock Island

GENERAL MOTORS
LOCOMOTIVES



ISLAND
THE ROCKET
625
Rock Island

of Safety has bestowed upon the entire railroad industry a "Certificate of Special Commendation" in "recognition of their outstanding contribution to the war effort" accomplished with due regard to considerations of safety. This unprecedented award was made at New York on June 28 by E. Roland Harriman on the occasion of the bestowal of the "Harriman Awards" for their 1943 safety records upon the Union Pacific, Eastern District (gold medal); the Duluth, Missabe & Iron Range (silver medal); and the Charleston & Western Carolina (bronze medal). On the same occasion, the Arthur Williams Memorial Medal was presented to Charles E. Carlson, retired president of the Duluth, Missabe & Iron Range "in recognition of outstanding contribution to the conservation of human life.

In his introductory remarks, before calling upon representatives of the winning railroads to receive the Harriman Medals at the hands of Mr. Harriman, R. V. Fletcher, vice-president of the Association of American Railroads and chairman of the Awards Committee of the Safety Museum, reviewed the railroads' safety record in 1943, calling attention to the ratio of three passenger fatalities per billion passenger-miles and one and a half employee fatalities per billion ton-miles—indicating that passengers were three times as safe on the railroads during the second world war as they were during the previous one and that employees are nearly six times as safe.

The criticism that has been directed against the railroads despite this record, said Judge Fletcher, makes it difficult for him "to resist the impression that much of this comment is inspired by overzealous methods of salesmanship employed by eager owners of patented articles, anxious to increase their sales."

Supply Trade Notes

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Huntly H. Gilbert,* vice-president in charge of sales of the Pullman-Standard Car Manufacturing Company, retired on June 30, due to ill health. Mr.

Huntly H. Gilbert

Gilbert, however, will continue to be available in a consulting capacity. In addition to his position as vice-president, Mr. Gilbert has been a director and member of the executive committee of Pullman-Standard. He was born in Chicago on February 10, 1887, and is a graduate in mechanical engineering of Cornell University (1907). After association with several steel companies, he joined the Pressed Steel Car Company in 1912. He was granted a leave of absence for 18 months during the first world war, serving with the Army ordnance department, first as a captain and later as a major. He then returned to the company and remained until August, 1933, when he became assistant to the president of the Pullman Car Manufacturing Company, and vice-president of the Standard Steel Car Company. Upon the merger of these companies into the present Pullman-Standard Car Manufacturing Company, on December 26, 1934, Mr. Gilbert was elected vice-president of Pullman-Standard.

◆

INDEPENDENT PNEUMATIC TOOL COMPANY.—*Henry H. Ritchotte,* manager of contractor tool sales at Philadelphia, Pa., has been appointed manager of the contractor's tool division of the Independent Pneumatic Tool Company with headquarters in Chicago.

◆

EUTETIC WELDING ALLOYS COMPANY.—*Dudley Rice* has been appointed a field engineer in the Chicago district for the Eutectic Welding Alloys Company. Mr. Rice had been a sales specialist on the welding products of the American Brake Shoe Company and prior thereto was with the Erie.

◆

PULLMAN, INCORPORATED.—The directors of Pullman Incorporated at a meeting in New York on July 19 decided, in order to carry out the requirements of the decree entered on May 8 in the United States District Court at Philadelphia, Pa., in the Government's anti-trust suit against the Pullman group of companies, to dispose of its sleeping car business, and to prepare a plan to effectuate such disposition for submission to the Court on or before October 5, 1944, for approval. The directors had notified its stockholders on July 8 (the day after the termination of the period in which Pullman could file an appeal) that the company would not appeal to the Supreme Court from the May 8 decree.

◆

NATIONAL BATTERY COMPANY.—*George S. Tanner* has been appointed manager, equipment sales, of the National Battery Company. Mr. Tanner has been associated with National Battery since 1926 when he became manager of radio power unit production. For seven years previously he had been with the Northwestern Bell Telephone Company. Subsequently, he was transferred to the engineering department of the National Battery Company where he was responsible for designing laboratory testing equipment. Following an assignment as sales engineer, Mr. Tanner became plant engineer of National's Dallas factory, the position which he held at the time of his appointment as manager, equipment sales. Mr. Tanner now directs

George S. Tanner

all activities related to the manufacture and sale of National's battery charging and testing equipment, and other related products. His headquarters are at the general offices in Saint Paul, Minn.

◆

TIMKEN ROLLER BEARING COMPANY.—Brace-Mueller-Huntley, sales representatives for Timken electric furnace alloy steels and Timken seamless alloy steel tubing, have also been appointed representatives for Timken stainless steels.

◆

STANDARD RAILWAY EQUIPMENT COMPANY.—*W. E. Bikle,* chief mechanical engineer of the Standard Railway Equipment Company, Chicago, has been appointed manager of the company's newly opened San Francisco, Cal., office.

Mr. Bikle was born at Hagerstown, Md., on July 16, 1898, and is a graduate of the Carnegie Institute of Technology, Pittsburgh, Pa. (1921). He entered the employ of the P. H. Murphy Company, New Kensington, Pa., as a draftsman and estimator in August, 1921, and was appointed assistant mechanical engineer in 1928. In

Army-Navy "E" Awards

Independent Pneumatic Tool Co., Aurora, Ill. Third renewal.

Pratt & Letchworth Co., Buffalo, N. Y. Second renewal.

Standard Stoker Company, Erie, Pa. June 23.

United States Rubber Company, Hogansville, Ga. June 20.

Whiting Corporation, Harvey, Ill. Second renewal.

February, 1936, he resigned to become mechanical engineer of the Chicago-Hutchins Corporation, Chicago, and was appointed chief mechanical engineer of the Standard

W. E. Bikle

Railway Equipment Manufacturing Company in July, 1939, when these two companies consolidated. In January, 1944, he was transferred to the sales force and on July 1, 1944, became manager of the San Francisco office.

◆

AMERICAN BRAKE SHOE COMPANY.—*Fred P. Biggs* has been named vice-president in charge of sales, and *Stephen S. Conway*, assistant vice-president, of the Brake Shoe & Castings and the Southern Wheel divisions of the American Brake Shoe Company.

Fred P. Biggs joined Brake Shoe as sales inspector in 1916 and became a salesman in 1921. He was appointed assistant vice-president of the Brake Shoe Company with headquarters in Chicago in January, 1934, and vice-president of the Brake Shoe &

Fred P. Biggs

Castings division in April, 1938. His offices will be in New York.

Stephen S. Conway joined the Brake Shoe Company in October, 1912, and has been in the sales department since 1929. His headquarters are in Chicago.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Perry T. Egbert* has been appointed vice-president in charge of Diesel locomotive sales of the American Locomotive Company, and *William S. Morris*, vice-president in charge of steam locomotive and divisional sales. Both will report to *Frank J. Foley*, vice-president in charge of sales.

Perry T. Egbert has served the company in sales capacities since 1921, when he was

Perry T. Egbert

appointed technical representative in the Far East. He returned to the U. S. in 1924. Mr. Egbert is a graduate of Cornell (1915), where he received a Mechanical Engineering degree. He was employed by the Lehigh Valley and Norfolk & Western and from 1916 to 1919 served as a pursuit pilot in the U. S. Air Corps. In 1920 he joined the Engineering Department of the American Locomotive Company.

WILLIAM S. MORRIS was formerly executive vice-president of the Montreal Loco-

William S. Morris

motive Works, Ltd., the company's Canadian subsidiary. He entered the locomotive business in 1922 as a special apprentice at the Schenectady, N. Y., plant. From 1926 to 1940, when he became vice-president of the Montreal subsidiary, he held various sales positions, including a four-year period as district sales manager at Chicago. He served in the U. S. Army during World War I and is a graduate of the U. S. Naval Academy (1922).

◆

DAMPNEY COMPANY OF AMERICA.—*Clarence J. Hunter* has been elected president and general manager, *J. W. Laverack*, vice-president and treasurer, and *J. Dwight Bird*, vice-president in charge of railroad and mid-west power sales, of the Dampney Company of America.

Clarence J. Hunter became associated with the Dampney Company as a manufacturer's agent in 1926 and as a regular employee in 1928. He was appointed general sales manager in 1931 and vice-president in 1932.

John W. Laverack, son of the late president, was associated with the Dampney Company for several years prior to entering the American Field Service in February, 1942. After serving in Egypt and North Africa for a year, he was transferred

Clarence J. Hunter

to the State Department, foreign service auxiliary, with headquarters in Cairo, Egypt. He returned to the United States in the spring of 1944 and resumed his association with the company.

J. Dwight Bird was formerly with the Southern Pacific. He later was employed in the steam turbine division of the General Electric Company and subsequently was in charge of mechanical maintenance of various Electric Bond & Share properties

J. Dwight Bird

in Texas. He became a manufacturer's agent of the Dampney Company in 1926 and a regular employee in 1930, after which he was appointed manager of the Chicago office.

◆

WYANDOTTE CHEMICALS CORPORATION.—The Wyandotte Chemicals Corporation, Wyandotte, Mich., which embarked upon

(*Continued on second left-hand page*)

1872

WESTWARD HO-

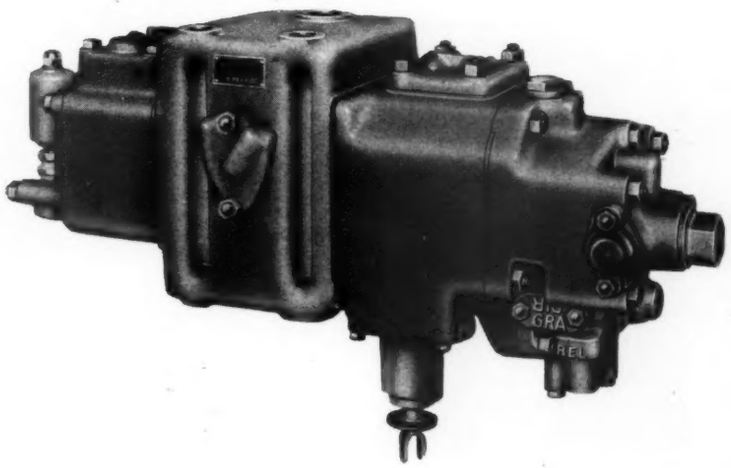
with an "Automatic Brakeman" on every car

Early trains needed a brakeman on every car. The Westinghouse "Automatic" Brake, introduced only three years after the first model appeared, put one there —to stay!

Installation of a Triple Valve and reservoir gave each car its own braking power and eliminated runaways when trains broke in two . . . an occurrence that was all too frequent in those early times. Crude by present standards, this automatic brake was the direct ancestor of the brake you depend on today. No change has been made in basic principles. And through all the stages of evolution, each new improvement has functioned interchangeably in combination with earlier models . . . a remarkable engineering achievement.

75 Years of Pioneering

WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PA.



1869 1944

TO PERMIT TODAY'S TRAINS TO MOVE AT SHORTER INTERVALS WITH HEAVIER LOADS AT HIGHER SPEEDS—SAFELY.

For a vivid picture of the progress in these 75 years . . . consider the Electro-Pneumatic HSC Equipment. Brakes respond instantly and sensitively throughout the train. The highest practicable rates of retardation are maintained by a speed governor which automatically proportions braking pressure to speed. Means may also be incorporated to prevent wheel sliding when rail adhesion is subnormal or spotty. Westinghouse Braking Equipment is always abreast of transportation needs.

a research program for organic products in 1939, has now formed a Development department to handle the development of both organic and inorganic products. *J. J. Schaefer,* formerly vice-president of Sharples Chemicals, Inc., has been appointed director of development. Mr. Schaefer is a graduate of the University of Dayton and Massachusetts Institute of Technology. From 1928 to 1934 he was a member of the technical staff of Niacet Chemicals Corpora-

J. J. Schaefer

tion. In the latter year he was appointed director of research of Sharples Chemicals Incorporated and in 1936 was elected vice-president of the same company.

◆

ELECTRIC STORAGE BATTERY COMPANY.—*Daniel P. Orcutt,* assistant manager of the New York branch of the Electric Storage Battery Company since 1921, has been appointed manager of that branch to succeed *F. F. Sampson,* who retired July 1 after 30 years of service. Mr. Orcutt was graduated from Denison University and Cornell University. He was in the engineering department of the Westinghouse

Daniel P. Orcutt

Electric & Manufacturing Co. from 1907 to 1910, when he joined the Electric Storage Battery Company as sales engineer of the New York branch.

◆

LUKENS STEEL COMPANY.—*Samuel D. Lemmon,* who has been research metallurgist for Lukens Steel Company, Coatesville, Pa., has been appointed assistant engineer of tests. Mr. Lemmon was born in Honey Brook, Chester County, Pa., and is a graduate of Coatesville High

S. D. Lemmon

School. He received his Bachelor of Science Degree in Engineering at Pennsylvania State College. He entered the employ of Lukens Steel Company in 1939 as an observer in the Research Department; became metallurgical investigator in 1940, and research metallurgist in November, 1943.

◆

SUPERHEATER COMPANY, LTD.—*H. E. Brown,* who has been elected vice-president in charge of operations of the Superheater Company, Ltd., as noted in the July issue, had been general manager and assistant to C. A. Odell, who is now president, since

H. E. Brown

March, 1934. Mr. Brown was formerly associated with the Canadian National. He joined the Superheater Company in June, 1926.

◆

BALDWIN LOCOMOTIVE WORKS.—*C. G. Green,* assistant to the divisional vice-president, locomotive and ordnance division of the Baldwin Locomotive Works, has been appointed to supervise the sales and service activities of Baldwin-Westinghouse Diesel locomotives, and *J. G. Broz,* sales manager, Diesel engine section, locomotive and ordnance division of Baldwin, has been appointed in charge of sales of Diesel engines and electric locomotives.

CHICAGO MALLEABLE CASTINGS COMPANY.—*Charles A. Benz,* whose promotion to general sales manager of the Chicago Malleable Castings Company, and its subsidiary, the Allied Steel Castings Company, with headquarters at Chicago, was reported in the July issue, was born at Chicago on February 12, 1897. He entered the railway supply business in 1916 as a draftsman of the Union Metal Products Company. In 1918 he resigned to become assistant chief draftsman of the Joliet Railway Supply Company and was later ap-

Charles A. Benz

pointed mechanical engineer and assistant to the general manager. In 1924 Mr. Benz went with the Chicago Malleable Castings Company where he organized the brake-beam department. After that department was in production he was appointed sales engineer, and in 1937 he was promoted to the position of manager of the Railroad divisions of the two companies.

◆

GRIP NUT COMPANY.—*J. L. Logan,* who has been associated with the Grip Nut Company for the past fourteen years, has been appointed southeastern sales manager.

◆

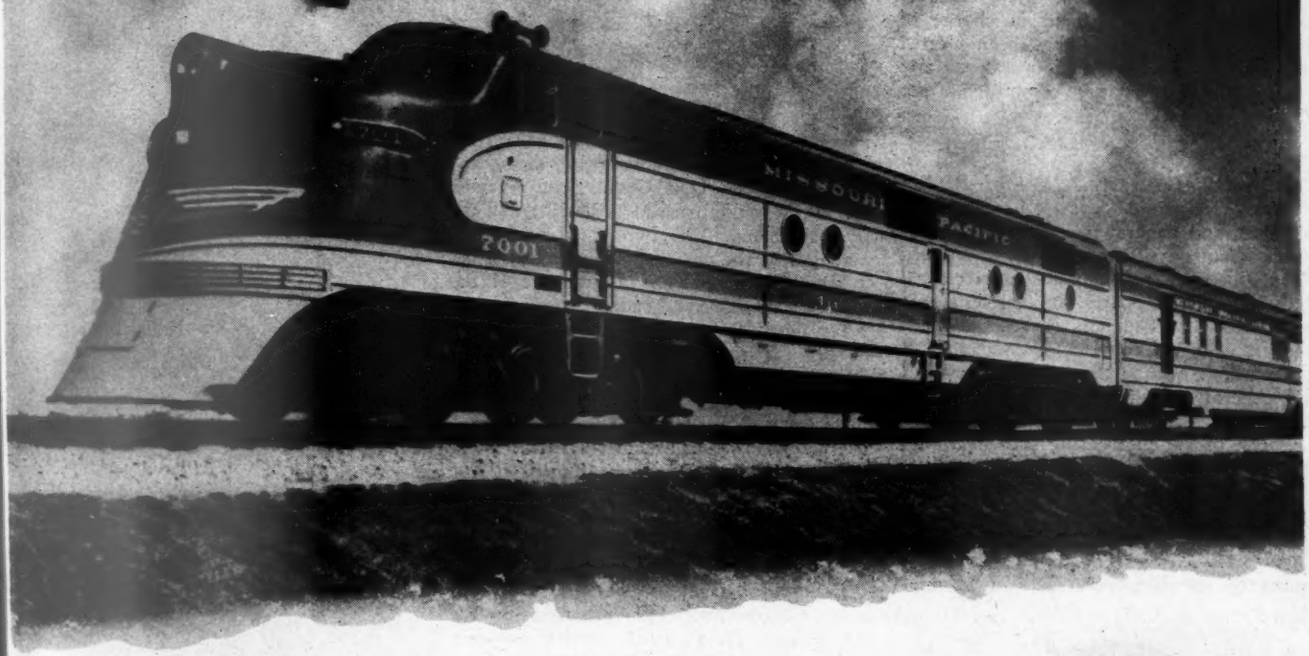
UNION ASBESTOS & RUBBER COMPANY.—*W. H. Fehrs,* manager of the Cicero, Ill.,

W. H. Fehrs

plant of the Union Asbestos & Rubber Co. has been appointed assistant to the presi-

(*Continued on next left-hand page*)

Onward with "The Eagle"



● In its daily 477 mile run between St. Louis and Omaha, the "Missouri River Eagle" of the Missouri Pacific Lines has established an outstanding record carrying capacity passenger loads. Few trains can equal the five year 'on time' performance of these splendid trains. Many features of modern railroading on the progressive Missouri Pacific Railroad make these records possible.

Playing an important part is the vital factor of lubrication. Sinclair Gascon Diesel Oil is used to lubricate the Diesels of the "Missouri River Eagles." In wide service this oil has made a high record for performance and economy.

Gascon, through inherent solvent action, keeps rings and pistons clean. Its wear-prevention qualities hold down costly replacements.

For counsel on lubrication problems Sinclair engineers are at your service.

SINCLAIR RAILROAD LUBRICANTS

SINCLAIR REFINING COMPANY, RAILWAY SALES, NEW YORK • CHICAGO • SAINT LOUIS • HOUSTON

dent in charge of railroad sales with headquarters at the company's main offices in Chicago. Mr. Fehrs was employed in the mechanical engineering department of the Union Pacific at Omaha, Neb., for 12 years. He joined the railroad sales department of Union Asbestos in May, 1928, and served as manager of automotive sales from 1932 to 1939. He was appointed assistant to the vice-president in 1939 and, later that year, manager of the Cicero plant.

◆

DEARBORN CHEMICAL COMPANY.—*H. G. Mastin,* service engineer of the Dearborn Chemical Company, has been promoted to district sales manager of the Eastern district with headquarters in New York.

◆

PHILCO CORPORATION.—*William Balderston,* formerly vice-president in charge of the commercial division, has been elected vice-president in charge of operations and a member of the executive committee of the Philco Corporation.

◆

DEVILBISS COMPANY.—*Howard P. DeVilbiss,* vice-president, has been elected president and general manager of the DeVilbiss Company, Toledo, Ohio, to succeed *Allen D. Gutchess,* who has been elected chairman of the board and active senior executive. Mr. Gutchess succeeds *W. M. Booker,* who will continue as a member of the board. *Frank A. Bailey,* vice-president and general manager, who has been with the company for 34 years, has retired. *Don J. Peeps,* of the engineering staff, has been appointed acting chief engineer.

◆

MT. VERNON CAR MANUFACTURING COMPANY.—*Richard T. Coyne,* sales engineer of the Enterprise Railway Equip-

Richard T. Coyne

ment Company, has resigned to become manager of sales of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., a division of H. K. Porter Company, Inc., Pittsburgh, Pa. Mr. Coyne will assume the duties of *C. M. Wright,* who has resigned as vice-president. Mr. Coyne attended Crane Technical High School and Northwestern University and later entered the employ of the Enterprise Railway Equipment Company as sales engineer.

EDWARD G. BUDD MANUFACTURING COMPANY.—*James M. Plaskitt,* formerly mechanical engineer of the Southern Railway, headquarters at Washington, D. C., has been

James M. Plaskitt

appointed regional sales manager of the Edward G. Budd Manufacturing Company, with offices at 1218 Connecticut Avenue, N. W., Washington. Mr. Plaskitt will report to Samuel M. Felton, general sales manager of the company's railway division.

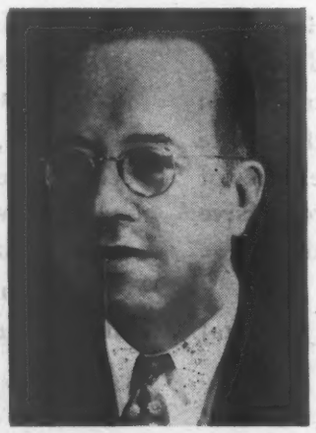
Mr. Plaskitt, who is a graduate of the United States Naval Academy, served in the Navy until 1924. He joined the Southern in 1924 as shop engineer and since then served in various positions with that road.

◆

BABCOCK & WILCOX TUBE COMPANY.—*Marcel A. Cordovi,* formerly research assistant, Welding Research Council of the Engineering Foundation, has been appointed research metallurgist of the Babcock & Wilcox Tube Co.

◆

ELECTRO-MOTIVE DIVISION, GENERAL MOTORS CORPORATION.—As reported in the April issue, *H. B. Ellis,* service manager of the Electro-Motive Division of the General Motors Corporation, has been appointed director of the Parts and Service division; *D. H. Queeney,* sales engineer, has been appointed service manager, and



H. B. Ellis

W. D. Davis, assistant service manager, has been appointed manager of the Parts division. In addition, *C. L. Olsen,* district service engineer at Miami, Fla., has been appointed manager of the Eastern region, with headquarters at New York, and *Thorwald O. Robertson,* district service engineer, at Los Angeles, Calif., has been appointed manager of the Western region, with headquarters at Los Angeles. These latter appointments were reported in the July issue.

H. B. Ellis joined the Electro-Motive Division in 1926 as assistant manufacturing superintendent, and two years later he was promoted to assistant service manager. In 1930 he was further promoted to the position he held at the time of his new appointment.

D. H. Queeney was appointed a member of the engineering staff of Electro-Motive in 1929. Prior to that he served as service

D. H. Queeney

manager of the Commercial Truck Company and as sales engineer of the International Motors Company.

W. D. Davis was a graduate of the General Motors Institute in 1933 and was as-

W. D. Davis

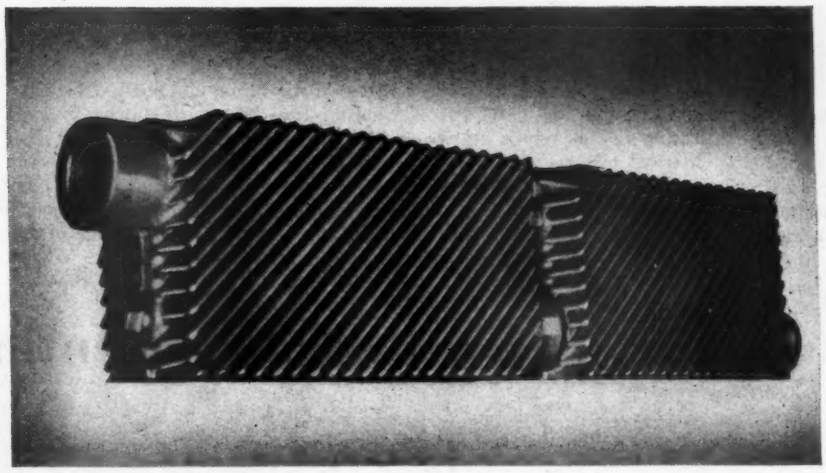
signed to the former Winton Engine division of General Motors. He was transferred to the Electro-Motive division when that organization was separated from the Winton Engine Division.

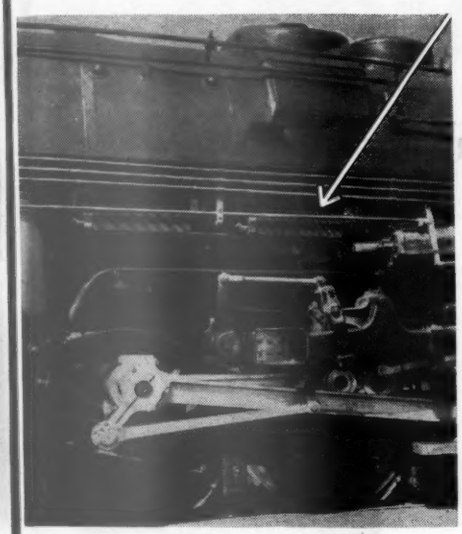
◆

MORTON MANUFACTURING COMPANY.—*Austin C. Ruse* has been placed in charge of railway sales in the Chicago, Omaha and Denver areas for the Morton Manufacturing Company. Mr. Ruse will maintain headquarters in Chicago.

(*Turn to next left-hand page*)

Wilson All-cast Elements, tested to 500 pounds per square inch before shipment. (For all heat exchange purposes)





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Wilson Radiation comprises compact all-cast elements, available for primary, intermediate, or final, locomotive compressed air cooling.

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Obituary

Leslie Flood, eastern sales representative of the Oxweld Railroad Service Company in New York, died June 14.

Arthur P. Hagar, sales representative, northeastern district, for the Safety Car Heating & Lighting Company, whose death on June 15 was reported in the July issue, was a graduate of the Stevens Institute of Technology, with a degree in mechanical engineering, in 1902. During his early career he was in the employ of the Illinois Steel Corporation at South Chicago, Ill., and the Rail Joint Company at Troy, N. Y. Mr. Hagar joined the Safety Car Heating & Lighting Company in 1908 and was in the engineering department and in charge of marine work for the company from 1908 to 1914. He was also in charge of laboratory and experimental work at the company's former plant at Jersey City, N. J., from 1912 to 1919. He was appointed sales representative of the northeastern district, with headquarters in New York, in 1919.

◆

H. Edward Manville, Sr., former chairman of the board of the Johns-Manville Corporation, died June 27 at the age of 72.

Personal Mention

General

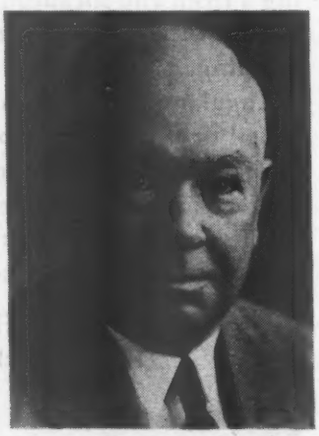
H. HAWTHORN, shop engineer of the Central of Georgia, has been appointed mechanical engineer at Savannah, Ga.

ROBERT HUNT, assistant general superintendent of motive power of the Seaboard Air Line at Savannah, Ga., has been appointed general superintendent of motive power, with headquarters at Norfolk, Va. Mr. Hunt, a native of Manchester, England, was born on February 16, 1888. He attended Manchester Technical College, where he

Robert Hunt

received a degree in mechanical engineering. Mr. Hunt entered railroad service in 1901 with the Great Central (Now London, Midland & Scottish), England, serving until 1909 as apprentice and draftsman. He entered American railway service in 1909 as a draftsman in the employ of the Atlantic Coast Line at Wilmington, N. C., becoming chief draftsman in 1913. In 1918 he went with the Seaboard Air Line as mechanical engineer at Norfolk, and in 1930 was appointed assistant general superintendent motive power.

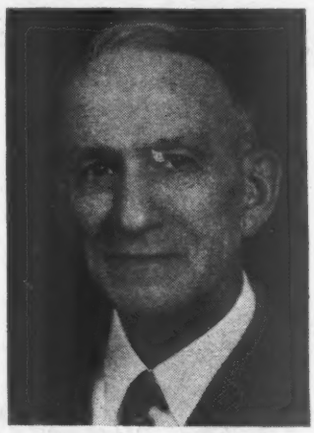
CHARLES A. GILL has resigned as vice-president in charge of operation and maintenance of the Reading. Mr. Gill entered railroad service in 1897 as a call boy in the motive-power department of the Baltimore & Ohio and later became a machinist apprentice in the Riverside shops, Baltimore, Md. He left the Baltimore & Ohio in 1901 and was subsequently employed on several other railroads as machinist or foreman. In 1909 he returned to the B. & O. as enginehouse foreman at Washington, Ind., later serving as master mechanic and general master mechanic. On February 1, 1917, he was appointed superintendent of motive power of the Eastern Lines of the B. & O. On February 10, 1931, he accepted from the Soviet government a year's appointment as chief consulting engineer of the railway systems of the Union of Soviet Socialist Republics. In that capacity he aided in the development of motive power and other equipment problems of the Soviet system and also advised in the expenditure of the 1931 Russian railroad budget, amounting to $1,700,000,000 and covering some 60,000 miles of line. Mr. Gill's first position upon his return from Russia early in 1932 was assistant to chief motive power and equipment of the B. & O. He became special representative of the Reading later in 1932



C. A. Gill

and in September of the same year was appointed superintendent motive power and rolling equipment of the Reading. His jurisdiction was extended to include the Central of New Jersey on September 1, 1933, and in 1936 he became general manager of the two companies. He was elected vice-president in charge of operations and maintenance of the two roads in 1941, and later in the same year also of the New York & Long Branch. He resigned as vice-president of the Central of New Jersey on July 1, 1943. Mr. Gill is a member of the board of directors of the American Standards Association, to which he was elected for a three-year term beginning January 1, 1943.

C. W. PFLAGER, mechanical superintendent of the Pullman Company, with headquarters at Chicago, has been appointed assistant vice-president, with the same headquarters. Mr. Pflager was born at St. Louis, Mo., and went with the Pullman Company in 1893 as a draftsman at St. Louis. In 1895 he was transferred to Chicago where he held several supervisory



C. W. Pflager

positions in the mechanical and repair departments. In 1918 he became mechanical superintendent.

J. M. BAILEY, supervisor of Diesels of the Seaboard Air Line, has been appointed general supervisor of Diesels, with headquarters as before at Savannah, Ga.

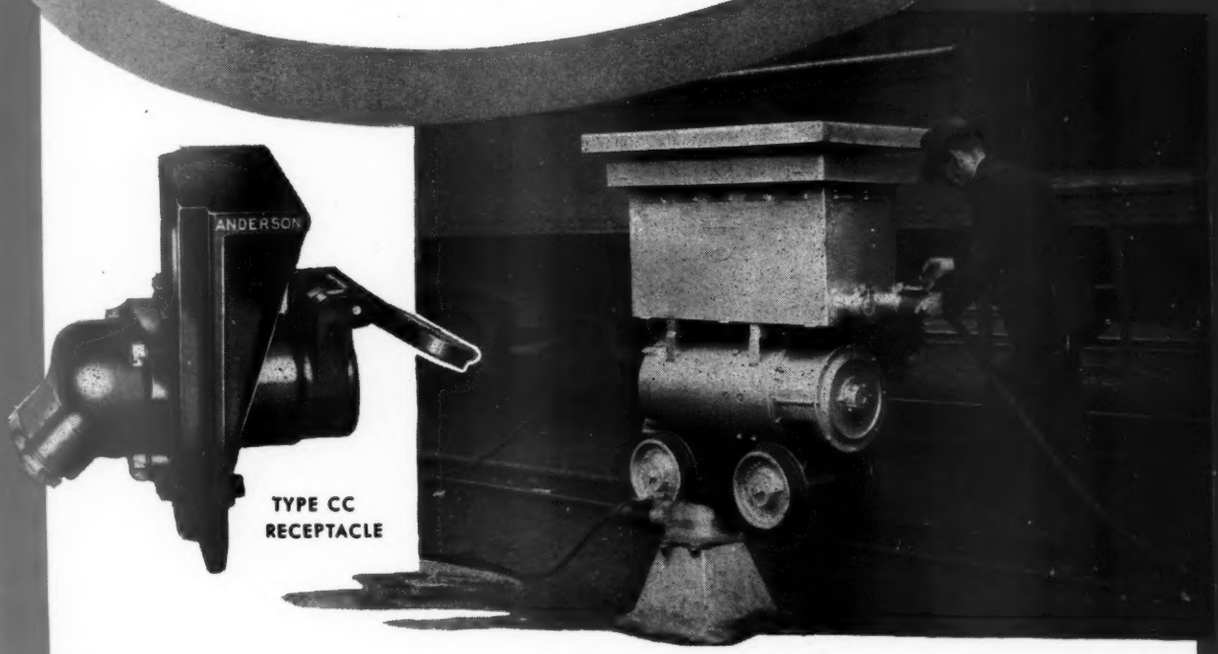
C. L. HARTSHORN has been appointed assistant to general mechanical superintendent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

C. O. JOHNSON, chemist in the employ of the Central of Georgia, has been appointed assistant mechanical engineer, with headquarters at Savannah, Ga.

CHARLES ROUNTREE SUGG, electrical engineer in the employ of the Atlantic Coast Line for more than 35 years, has retired from active service. Mr. Sugg was born on September 23, 1876, in Greenville, N. C. During his early youth he served in the House of Representatives, North Carolina State Legislature and North Carolina State Senate as page and assistant chief page, respectively. He entered the employ of the Government Printing Office, Washington, D. C., in October, 1893, as messenger, holding vari-

(*Continued on second left-hand page*)

ALL ANDERSON PLUGS AND RECEPTACLES IN THIS INSTALLATION



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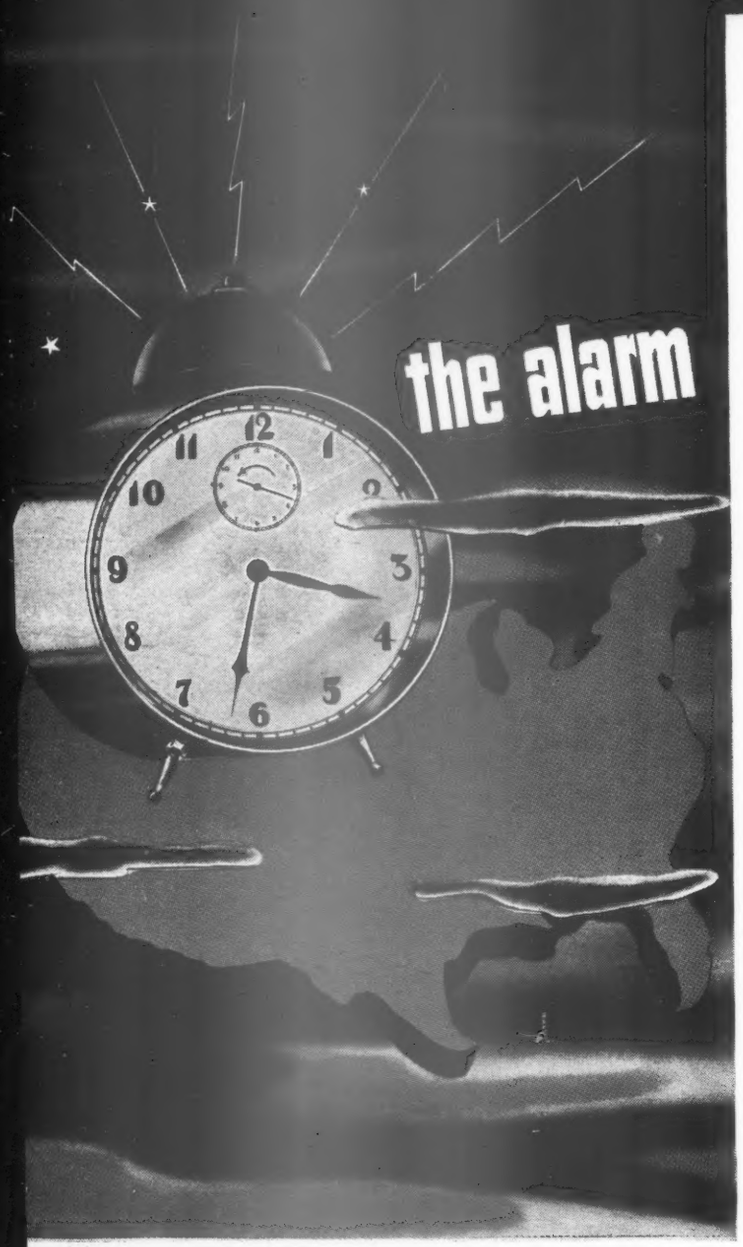

rang months ago!

At 3:32 A. M. Eastern War Time, June 6, 1944, the offici announcement of the invasion of "Fortress Europe" w released by General Dwight D. Eisenhower. It marked t opening of the second front—the greatest event of all time. the beginning of the end of the war. It sounded the alar for management to wake up and definitely plan for peac

To talk about postwar plans is not enough. Now is the ti for actual, factual planning and doing if private enterpri is to survive. *The alarm rang months ago.*

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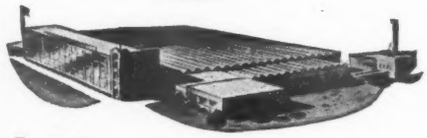

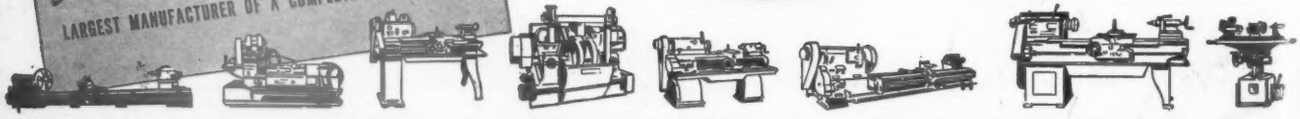

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